LONE STAR parachutes

Builder`s Assembly Manual

Lone Star Parachute Company

Canopy Assembly Manual

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Manual Serial Number:

Canopy Serial Number:

Introduction

This project has been a long time coming and required considerably more work than I ever expected, but as the manual goes to press, I'm looking forward to seeing a spirit come back into skydiving that has long been lost. When I started jumping in the '60s, skydiving was still a new idea; everybody jumped military surplus gear and everybody worked on his own equipment, usually with the help of the club rigger if the club was fortunate enough to have a real rigger. It was assumed that each person was responsible for himself and his equipment, and almost everyone tinkered around with his gear to some degree. If you needed a new deployment sleeve, you made one. I made an ugly paisley one that I was very proud of for some reason. If you didn't like the color of your canopy, you took it out in the backyard and dyed it in a wash tub. I had a nice red one, lines and all. The result of all this was that the high tech gear of today grew out of the basements and garages of early skydiving, and a new industry developed to provide good ready-to-jump equipment. At the same time, general rigging skills disappeared from the jumping population. The greater loss, however, was the camaraderie of getting together during the week to do the little odd jobs on our equipment, to discuss this or that rigging or jumping technique and to help new jumpers make their first sleeve or extend their old, tight B-12 container. These gatherings were like small old-fashioned barn raisings. But lost also was the satisfaction of knowing you could count on yourself, on the work of your own two hands. It's a good feeling. If you have this spirit to be more than just a weekend jumper, this project is dedicated to you and jumpers like you, jumpers who seek the greater challenge, the greater accomplishment.

I would like to thank, in project chronological order, the key people who made the project possible. Jan Walker did the early market survey which got the project started and advised on the marketing start up. Manley Butler provided engineering and design advice and came up with several key technical ideas that were incorporated into the kit. Henry Stone designed and built the oversized silk screening system for printing the fabric parts. Craig Buxton built several of the early test canopies. Vi Sandberg set all the type, Vickie Kincaid assisted with the paste up chores and J. Hughey shot the negatives and halftones. All three spent many an hour after their regular jobs on the project. Haydee Cano proof-read the manual and also helped develop and proof-sew the final canopy patterns as did David Sebesta. Haydee also helped at the somewhat premature introduction at the '84 Nationals. Jack Josey made available the facilities at KGTN for production of the cassette tapes and Linda Scarbrough made available the facilities of the Williamson County Sun for production of the manual. The manual was printed by J. A. Tooke. Scott Hamilton's law office provided legal advice and services.

Thanks, folks.

Clark Thurmond
Georgetown, Texas
May 19, 1985

WARNING

You are about to undertake to assemble a parachute canopy from a kit of raw materials. Each time you use the completed canopy, you will be risking serious bodily injury, including death.

You can substantially reduce this risk by assuring that this parachute canopy is assembled in strict compliance with the instructions contained in this manual, by having the completed parachute canopy inspected by the seller of this kit, by packing the canopy and operating it in strict compliance with the owner's manual, and by obtaining proper instruction in the techniques of parachuting and in the use of parachutes of this type.

However, parachute canopies sometimes fail to function even when properly assembled, inspected, packed and operated. Thus, you risk serious injury, including death, each time you use this or any other parachute canopy.

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Every Skydiver I know can do something rather extraordinary, he can step out of an airplane with less difficulty than most people have getting out of bed. You have proved that you have the ability to tackle a difficult program and complete it. The fact that you didn't know how when you started made no difference, you just started with that first jump and then made another and another until that little problem of not knowing how was brushed aside.

Building Your Skills

Building your parachute is not nearly so hard as learning to skydive and if you apply yourself in the same patient, determined way, you'll have a rare accomplishment, one even many other skydivers won't have. Sewing is not an art, it is a skill, one that can be learned like any other skill. The only secret is . . . practice.

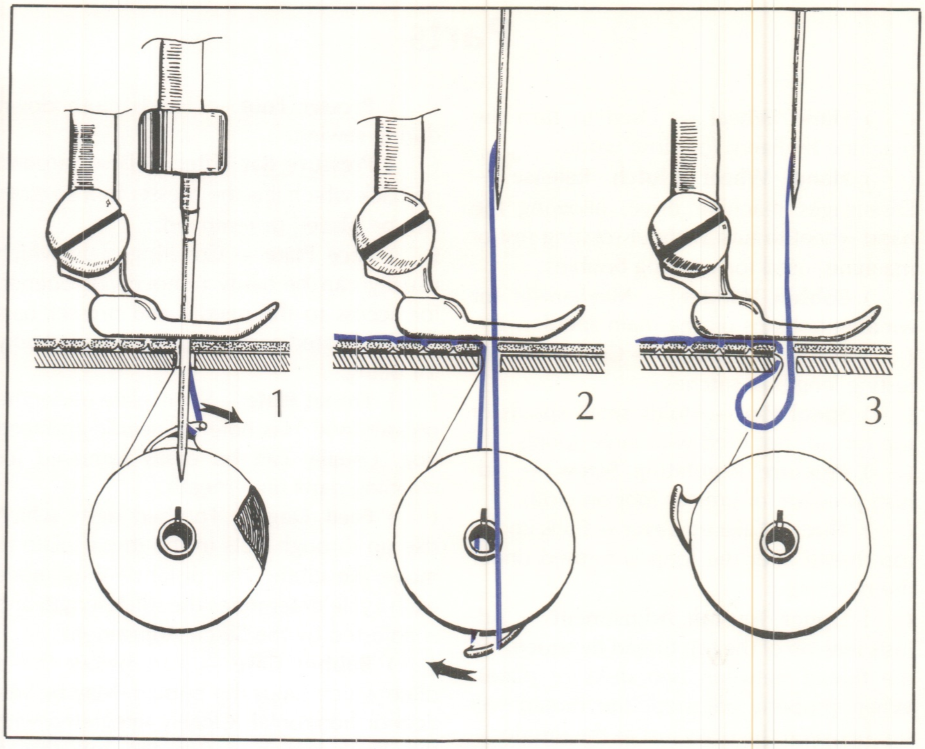
First, you'll make friends with your machine. It's important to have a general idea of how the machine does its job so you can make sure it's doing it right. Next, we'll get into the sewing part. The main things you have to learn are proper stitch form and control of the fabric as it goes through the machine. Since the nylon is so light, it requires some special skills in handling, skills that are simple and easily learned with a little practice. If you haven't had any sewing experience, you'll feel pretty awkward at first, everyone does, but just keep at it and it'll smooth out. If you already have experience, check out the skills section anyway, you'll probably pick up a hint here and there, and do spend some time warming up on the scrap material. When you're working on the skills section, remember, sewing is not an art, it is a skill that is mastered by practice. It is possible to work through the skills section pretty fast, but you'll get better results if you pace your training. Four ninety minute sessions are better than two 3 hour sessions. It may take a few days longer to get through the work but you will get more out of it in the end. The only difference between you and someone who sews for a living is speed. After working through the skills section and a little practice, you'll be able to sew as accurately as the folks sewing store-bought canopies, you just won't sew as fast.

One nice thing about sewing, if it looks right, it is right and if it's wrong, you can see it. There's no hidden mystery about the sewing itself. If you make your stitching look like the photographs and samples, you're doing it right. Work until you get it there.

The Basic Operation

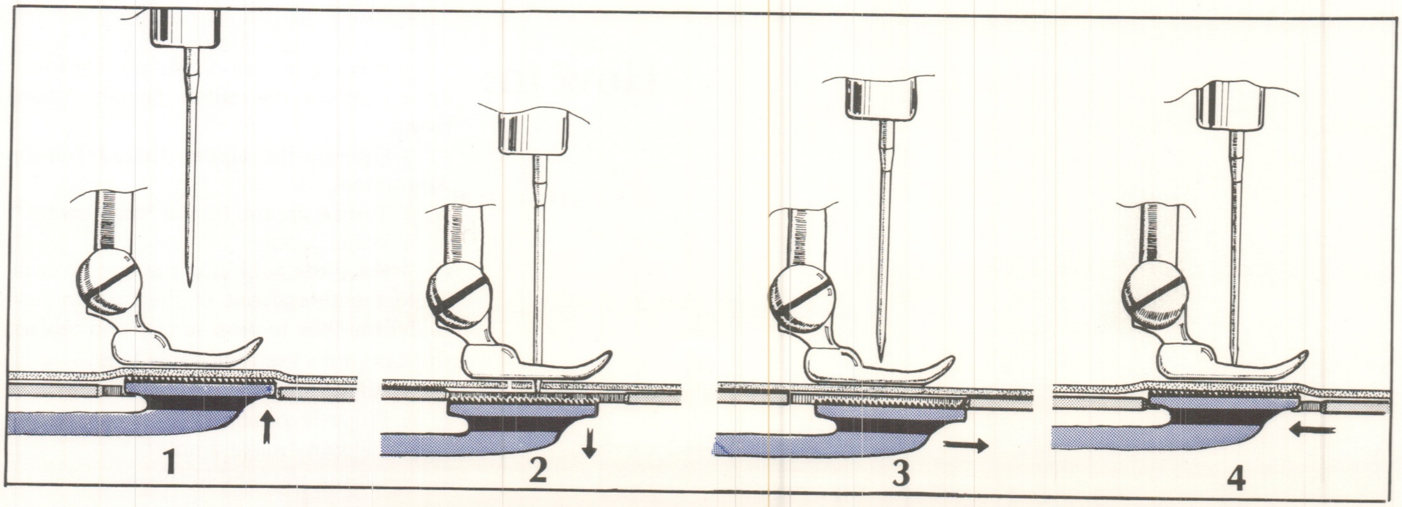
No matter how complicated your machine may look, it does one very simple thing, over and over. It uses two threads, one above and one below the cloth to form an interlocking row of stitches with the cloth in between. The top thread (or needle thread) feeds directly off the main spool, while the bottom thread feeds off a smaller spool, the bobbin, positioned under the machine. The needle goes through the material, carrying the top thread with it. A small hook underneath grabs the top thread and pulls it down and around the bobbin. After going around the bobbin, the top thread is pulled back up, forming a loop around the bobbin thread. While this is going on, another mechanism, the feed dog, reaches up, gets a grip on the underside of the cloth and pulls it forward a short distance, positioning the material for the next stitch.

This stitch is called a lockstitch; it's simple and strong and does not come unraveled if one of the threads is broken. It is the type that every domestic machine makes and is the type commonly specified for parachute work. It can be done in various patterns, but the basic stitch formation is the same. For instance, a zig zag stitch is just a simple lockstitch that is made from side to side instead of straight in a row. There are many specialized stitches and machines to do them, but for building a ram air canopy, the only stitch used is the lockstitch, straight and zig zag. Your canopy is designed to be built with a single needle, straight stitch machine although if zig zag is available, it will speed up some jobs.



The machine forms each stitch by passing a loop of top thread around the bobbin. ***1.*** *After the needle brings the top thread down through the cloth, the hook catches the top thread lying alongside the needle.* ***2.*** *As the needle begins to retract, the hook carries the loop of top thread down and around the bobbin.* ***3.*** *Once around the bobbin, the top thread is pulled back up to form a tight loop around the bobbin thread running along the bottom of the cloth. On some machines (shuttle type), the hook backs up to its start position. On most domestic machines, the hook continues around and catches the thread the next time the needle comes down (rotary type).*

The cloth is moved through the material in strict timing with the stitch formation. ***1.*** *The cycle begins with the feed dog raised up, holding the cloth tightly against the presser foot above as the needle descends.* ***2.*** *As the needle enters the cloth, the feed dog drops below the surface.* ***3.*** *While the stitch is being formed, the feed dog moves into position to start the next stitch.* ***4.*** *As the top thread loop is being pulled up, the dog raises up, grabs the cloth and pulls it forward, stitch and all. Its forward travel comes to a halt about the same time as the stitch is being pulled up tight. As the needle descends, the cycle starts over.*



Exercise 1
Know Your Machine

In order to operate your machine with confidence and skill, you must have a ready knowledge of its main parts, their function, and the adjustments which you'll have to make from time to time. It's possible to spend hours of frustration with some difficulty when a tiny bit of knowledge would solve the problem at once. Spend time learning your machine now, it'll pay off later.

If you have the manual to your machine, study the sections describing the parts and how they work. As you learn the location and function of each part, check off that item in the list below. This is your 'must know' list. Next, learn how to do the things listed in the "How To" list after the Parts list. Check off each item as you've learned it.

If you don't have the manual, have someone who knows your machine go down the list and explain each item. Do the same for the 'How To' list. **Make notes** on threading the machine, etc., it's easy to forget until you're used to it.

Parts

( ) **Hand Wheel —** Used to turn the machine by hand, for close work.

( ) **Hand Wheel Clutch Release** — Disengages machine drive, allowing the hand wheel to turn without rotating rest of machine, used for winding bobbins.

( ) **Bobbin Winder** — Mechanism for winding bobbins off the main spool.

( ) **Stitch Adjustment** — Control for adjusting length of stitches.

( ) **Spool Pin** — Holds small spools of top thread, not used with large spools.

( ) **Pressure Regulating Screw** — Adjusts pressure of presser foot on cloth.

( ) **Thread Take up Lever** — Pulls up the top thread after the loop is formed under the machine.

( ) **Upper Tension Adjustment** — Adjusts tension of the top thread by squeezing the thread between two disks or plates. When properly adjusted, the thread will slip between the disks just as the interlocking loop is positioned in the center of the cloth by the upward pull of the thread take up lever. Also, it will allow just enough thread to skip by for the next stitch.

( ) **Presser Bar** — Has presser foot on end. The other end is indirectly connected to the pressure regulating screw via a spring which pushes the presser foot down against the cloth. Tighten the screw, and you get more pressure on the cloth.

( ) **Thread Controller Spring** — Small spring wire usually associated with the upper tension adjustment. It prevents the thread from looping around the needle as it goes down for each stitch.

( ) **Needle Bar** — Vertical bar to which the needle is attached.

( ) **Needle Clamp** — Little clamp which holds the needle to the needle bar. If yours requires a screwdriver, get one that fits, you'll need it.

( ) **Presser Foot** — Holds cloth down during sewing.

( ) **Pressure Bar Lifter** — Lever around on back which lifts the presser foot so cloth can be placed or removed.

( ) **Face Plate** — Covering plate which usually can be easily removed or opened for access to the needle and presser bars and associated parts. Usually removed only for oiling.

( ) **Throat Plate** — Shiny plate under the presser foot. Has hole for needle and feed dog. Usually can be easily removed for cleaning parts underneath.

( ) **Feed Dog** — Toothed parts which rise up through slots in the throat plate to move the cloth. The distance they move each cycle determines the stitch length and is adjusted by the Stitch Adjustment.

( ) **Bobbin Case** — Part below throat plate which holds the bobbin. May be vertical or horizontal. Closely integrated with the hook which passes the top thread around both the bobbin case and the bobbin inside. Some cases are removable, others are not.

( ) **Lower Tension Adjustment** — Somewhere on the bobbin case. It's a tiny screw that is turned in or out to tighten or loosen a flat little spring which presses against the bobbin thread as it exits the bobbin case. Usually once you get this adjusted for a particular thread, you won't have to worry about it as almost all tension adjustments are done with the upper tension adjustment.

( ) **Speed Control** — Usually a foot control which varies the amount of electricity going to the motor. Some cabinet machines have the control mounted for knee operation.

( ) **Bobbin** — Small spool for lower thread supply. Each mahcine usually has its own design, get a bunch of the right ones.

How to:

( ) Adjust pressure on the presser foot.

( ) Operate the Stitch Length Adjustment.

( ) Operate the Upper Thread Tension Adjustment.

( ) Thread the top thread *make notes*.

( ) Wind bobbins.

( ) Place the bobbin in the bobbin case, route the thread out of the bobbin case under the little tension spring, and replace the case if it's the removable type.

( ) Adjust the lower thread tension.

( ) Properly position the needle in the needle clamp *make a note*

( ) Lift out the bobbin thread.

Exercise 2
Cleaning and Oiling

You mainly want to keep your machine clean so you don't get your parachute dirty. From a functional standpoint, dirt won't hurt much except in the bobbin case area. This area is the heart of the operation and has the most delicate parts, dirt here can mess up your stitch right away. You can remove the throat plate and clean the area with a small lint brush made for that purpose. A couple of cleanings during the period of your project will probably be enough, but check occasionally to make sure. Keep a soft cotton rag handy to wipe up excess oil, and before each sewing session, check the machine, especially around the needle and presser bars.

If you are sewing only a few hours a day, once a week oiling is usually enough. If you sew all day long, once a day is necessary. The area around the bobbin case will dry up first and must be checked and oiled more frequently than the rest of the machine. Too much oil here is better than not enough. Keep another cotton cloth handy to sew on after each oiling to soak up any extra oil that may be swept up by the bobbin thread. If you get a little oil on your canopy or thread, it will evaporate eventually without harm but it should be avoided. Use sewing machine oil, it won't gum up your machine.

With the help of your machine manual or informed person, go through the check list below.

Procedure

( ) Remove the needle, presser foot, and throat plate.

( ) Brush out the area underneath around the bobbin area (remove the bobbin case if it comes out).

( ) Turn the machine by hand and oil those places in the bobbin area indicated in the manual or those places where you see metal rubbing on metal.

( ) Replace the bobbin case, throat plate, presser foot, and needle.

( ) Locate and oil oiling points on top of machine (2-3 drops per hole).

( ) Open or remove face plate and locate and oil oiling points (1 drop each). Close plate.

( ) Locate and oil oiling points underneath machine (1-2 drops).

( ) Run the machine at a moderate speed about 15-20 seconds.

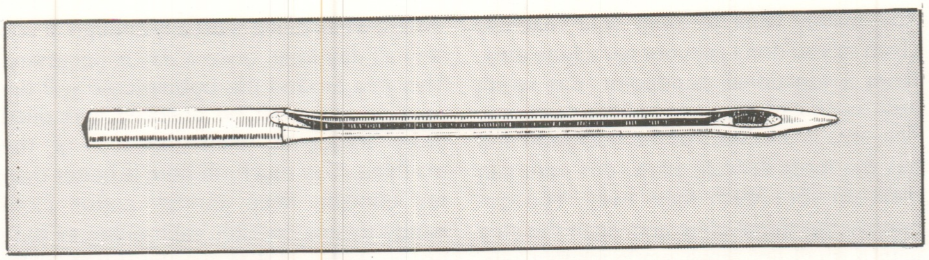
( )Wipe up any excess oil that has appeared.

Notes:

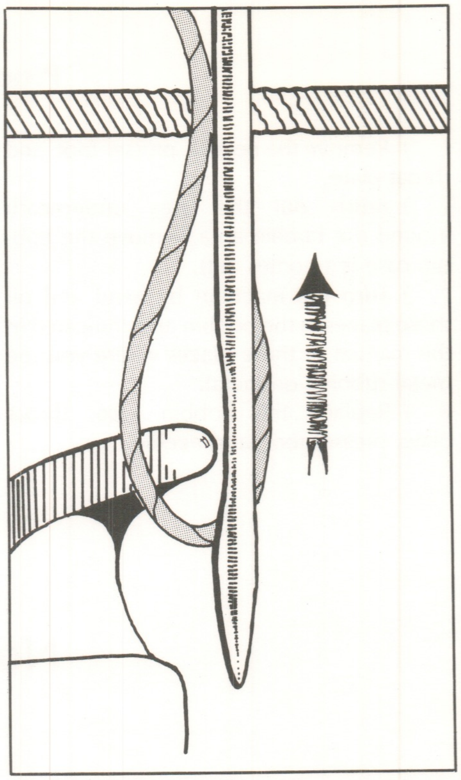
The Needle

The needle must gently force its way through the cloth, carrying the top thread with it, cause the thread to form a small loop in just the right place so the hook can catch it and draw the top thread around the bobbin case. Needles come with several different points and the preferred type for canopy work is the "ball" point. This type does not cut through the cloth; it shoves the yarn threads gently aside without breaking them and they can close up tight around the stitch after the needle is out. While the needle is still in the cloth, the hook will be pulling top thread down past the needle, and a long thread groove is provided along one side of the needle to allow the thread to pass easily.

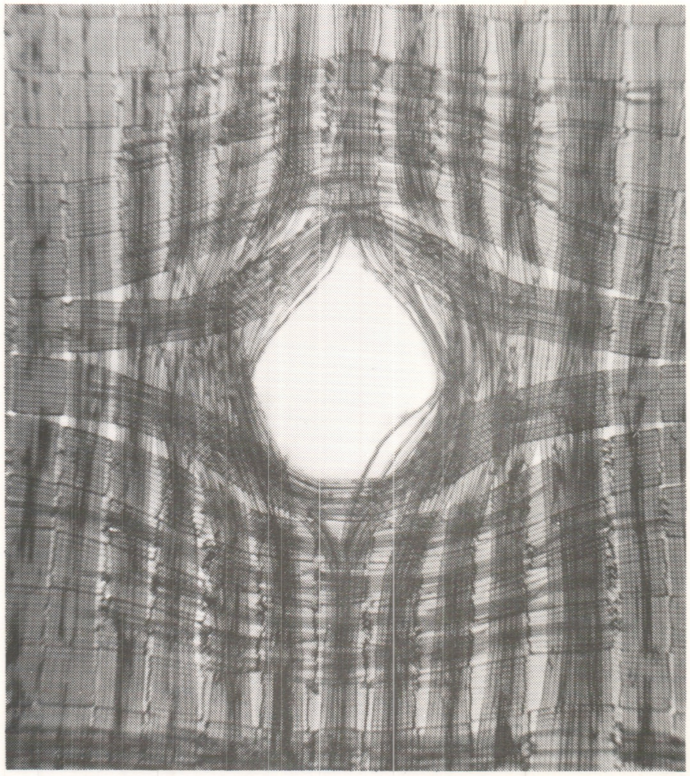
Since parachute thread is fairly large compared to regular thread, you must use a larger needle than normal. Use size 18, larger makes too big a hole and smaller doesn't fit the thread well. I recommend Schmetz brand, it's a quality product, very well finished. The length of the needle is more critical than its diameter. If it's too short, the loop will be too high for the hook to catch it and if it's too long, it might bang against the bobbin case. Buy a dozen or so and change them whenever they get dull.



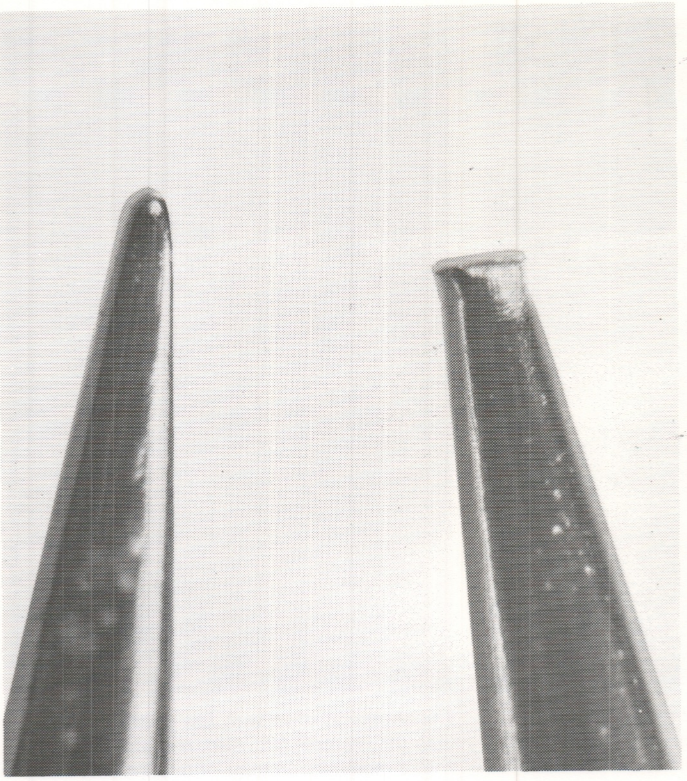
The needle has a long thread groove which provides a channel for the thread. The point may feel sharp but is actually gently rounded to push the yarn threads aside instead of cutting through them.



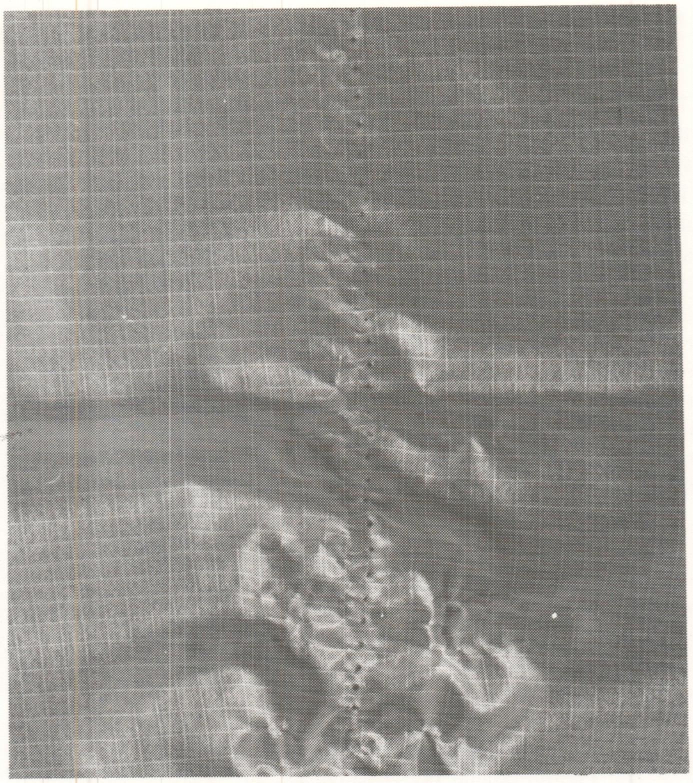
As the needle begins to go back up, the length of thread not hidden in the long groove is pinched against the back side of the needle by the cloth and does not move. This causes a loop to form on the back side of the needle and this loop is caught by the passing hook. Most domestic needles have a shallow cutout on the back side where the loop forms (called the scarf), allowing the hook to come closer to the needle. If you use a straight needle, the hook will hit the needle if it does not have this cutout.



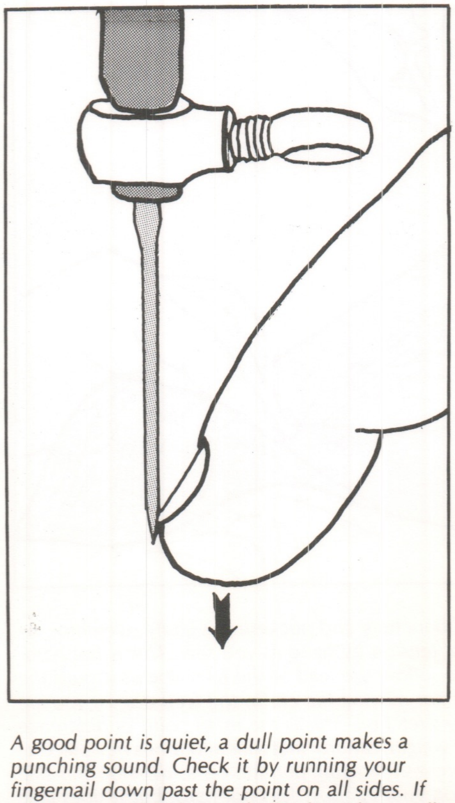
The 50x enlargement of a single needle hole shows how the ball point needle shoves the yarn aside without breaking it. Note how tightly parachute fabric is woven.



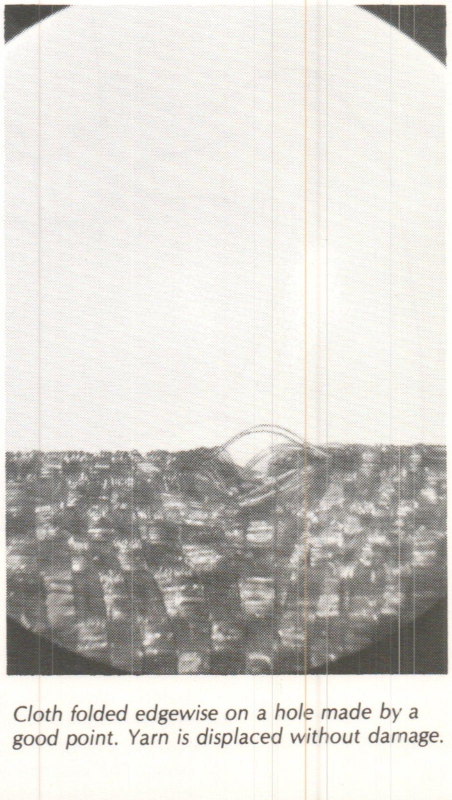
These needle points magnified 50 times show the difference between a proper rounded point and one which has been dulled. The right hand point will damage the cloth on every stitch, so dull needles must be replaced at once. If you pull too hard on the cloth, the needle will hit the cloth, then be pulled off center, causing it to hit the edge of the hole in the throat plate.



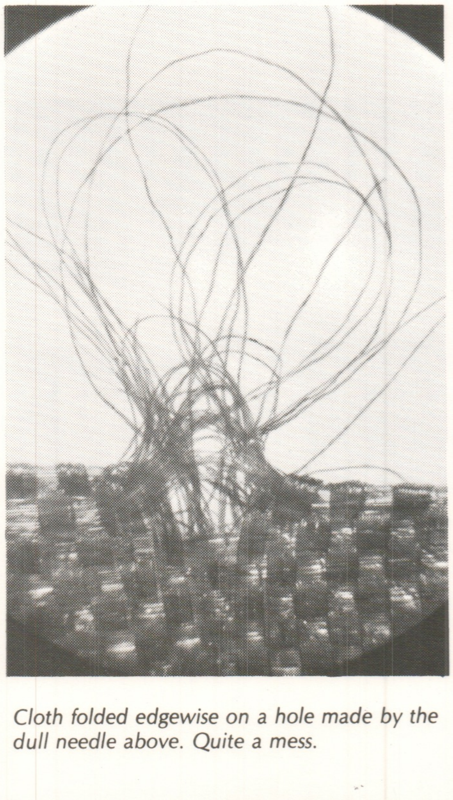
The upper half of this cloth was stitched (without thread) with the sharp needle on the left. The lower half was stitched with the dull needle. Notice how the lower half is pulled and damaged. Make sure your needles are in good condition.



A good point is quiet, a dull point makes a punching sound. Check it by running your fingernail down past the point on all sides. If it's dull, you'll feel a catch. Replace the needle.



Cloth folded edgewise on a hole made by a good point. Yarn is displaced without damage.



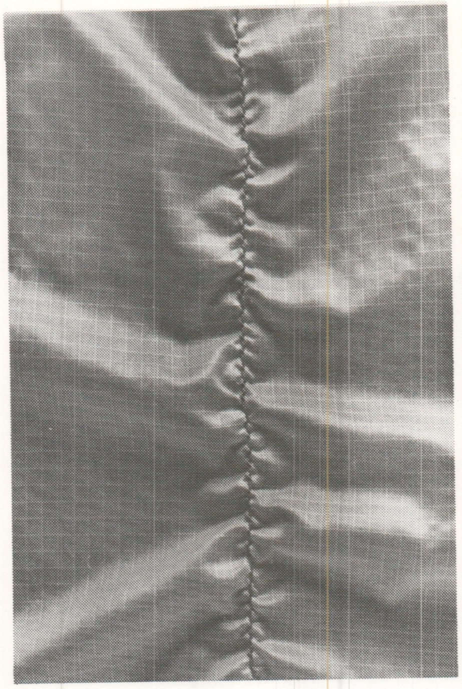
Cloth folded edgewise on a hole made by the dull needle above. Quite a mess.

Sewing on Nylon

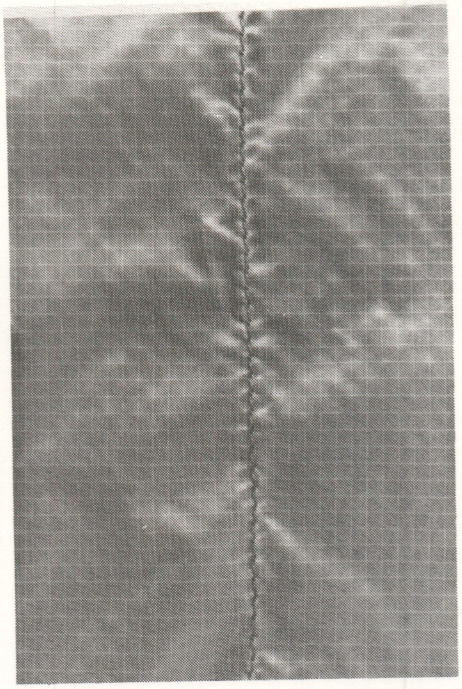
The material used in your canopy is very thin, less than 2 thousands of an inch thick, while the thread is much thicker, around 10 thousands of an inch. In addition, both items are elastic. These properties cause some problems that you don't find in normal sewing. The tendency of the thread to stretch a bit in the stitch forming process results in excessive puckering of the finished seam. Aside from being ugly, this can cause the long seams of the canopy to vary in length and the result can be an unsymmetrical canopy that may turn. Strength of the finished product may be reduced.

We do two things to reduce this tendency to pucker. First, we sew with as little tension in the thread as possible. This keeps to a minimum, stretching of the thread as the stitch is formed. When adjusting thread tension, you'll set it as low as you can and still maintain a good stitch.

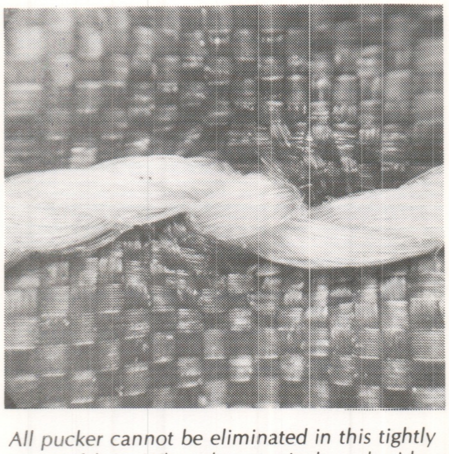
Secondly, we sew the material with a little stretch, applied by hand. If the thread stretches slightly during the stitch forming process and the material is also stretched, both can shrink evenly after the stitch has formed. Also, a little stretch behind the needle prevents the thread from pulling the previous stitches tighter after they've passed from the presser foot. This method will minimize puckering of the seam.



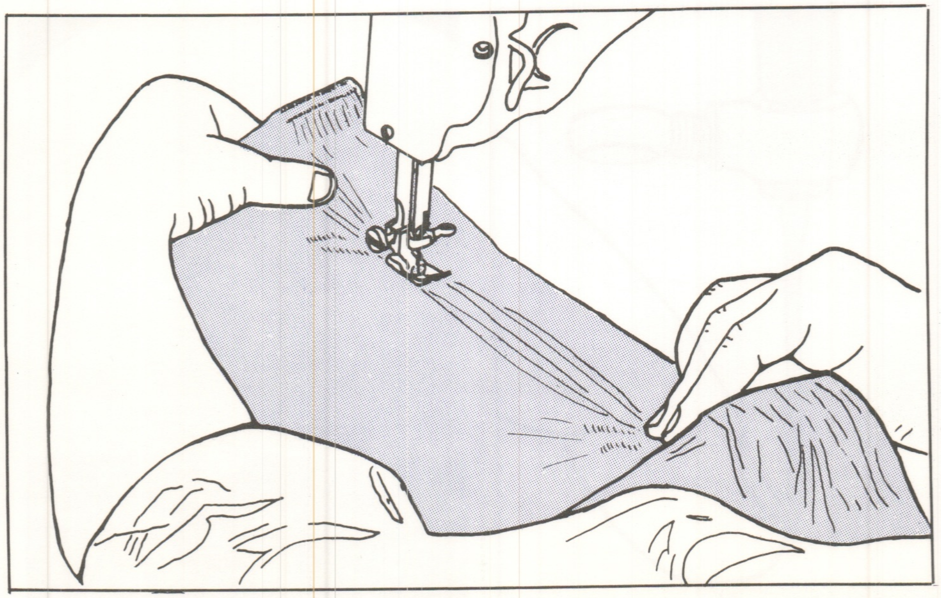
Too much tension in the thread and lack of tension in the fabric during sewing results in excessive puckering of the material. The stitches will tend to bunch up, giving you more stitches per inch than you desire. The seam will draw itself shorter than normal and may stretch unevenly under load. Failure to control pucker during the sewing process could result in an unsymmetrical construction causing a built in turn. Strength of the canopy may be reduced.



This seam was sewn with less thread tension than the example left. Also, the fabric was sewn with a moderate amount of tension. The result is a seam with only the normal pucker from yarn displacement. The balance between thread and fabric will permit an even stretching under load. Tension in the fabric also prevents the stitch from bunching up.



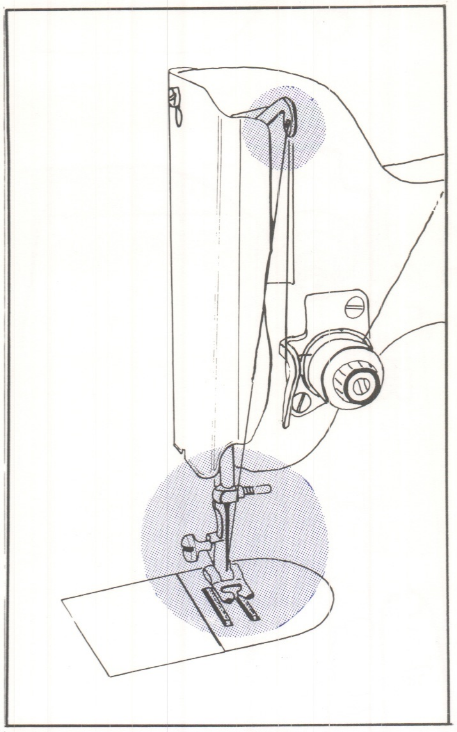
All pucker cannot be eliminated in this tightly woven fabric. When the yarn is shoved aside by the needle, there is no empty space for it to go to and a little ripple results around every stitch hole.



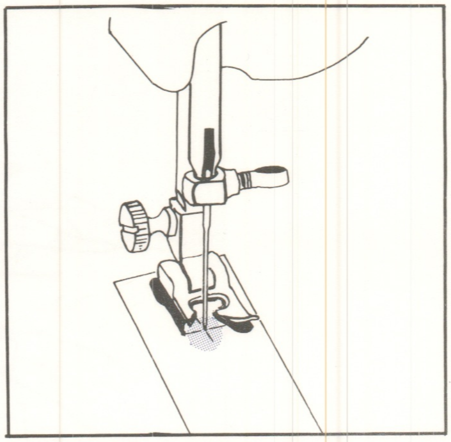
The problem of bunching and puckering is easily overcome by applying a slight amount of tension by hand as you sew. This is not hard, but you must learn how to follow the lead of the feed dog as it pulls the material along. You are not moving the cloth, the feed dog is, you are keeping the material slightly stretched. This is the main point of difference between sewing on light weight canopy material and a heavier piece of fabric. The practice exercises following permit you to develop this skill before you start sewing on your canopy. It is not hard, but it does take some practice.

Getting Started

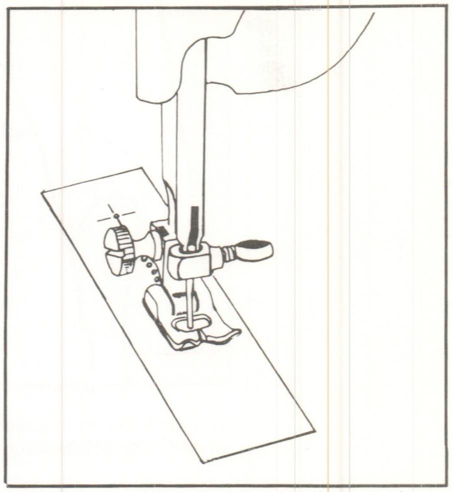
The next series of exercises concentrates on guiding the material through the machine. Later you'll thread up the machine and learn how to adjust stitch balance. It's important to develop good habits in starting and stopping your sewing, do it the same way every time and you'll have no difficulty. In getting started, have the presser foot up, turn the hand wheel until the needle is at its highest position and place the material in position under the needle. Lower the needle into the cloth at the point where you want to start, lower the presser foot and start sewing. When you end your stitch, turn the needle to its highest position, raise the presser foot and remove the material. In guiding the material through the machine, you should assist the action of the feed dog but not pull or push so hard that you are moving the cloth when the needle enters it. The first series of exercises is done on paper without thread in the machine. You'll be concentrating on positioning the machine properly for starts and stops, and guiding material through the machine. Of course the paper does not require any stretching as does the nylon, however, you should get in the habit of using the hand position illustrated.



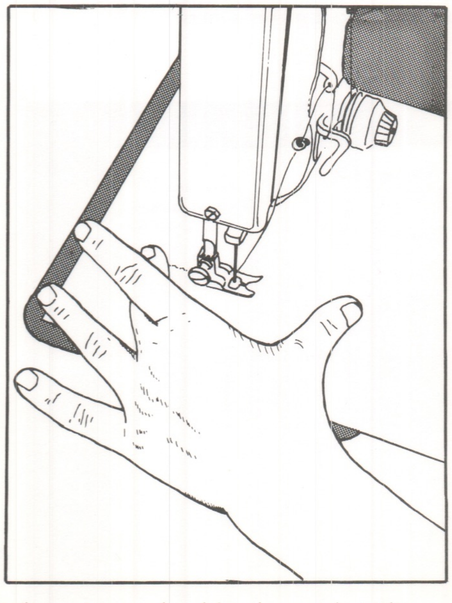
The starting and stopping position. Needle and presser foot up. Never run the machine with the presser foot down unless you have cloth in place. The feed dog scratches up the presser foot and dulls itself.



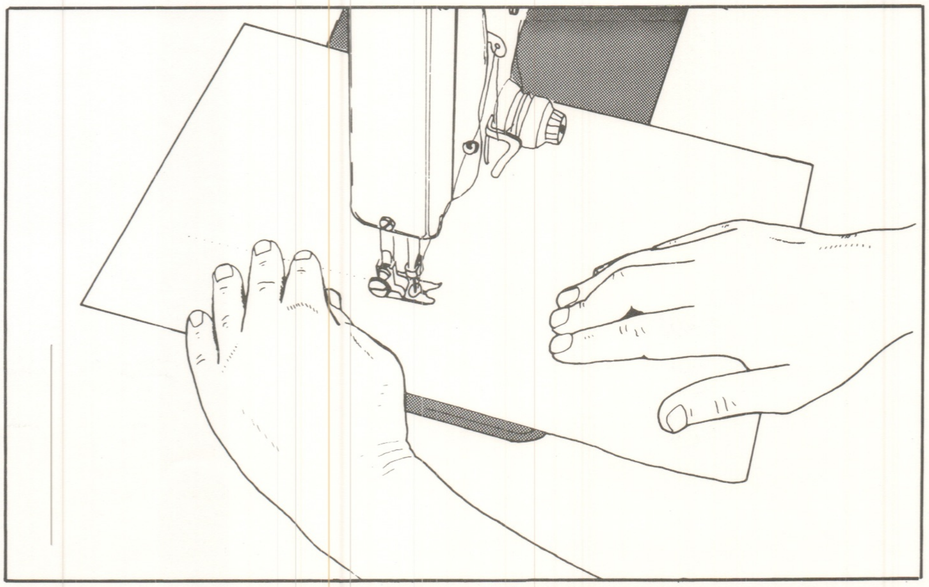
To start, with presser foot up, lower the needle into the material at the point where you want to begin.



Next, lower the presser foot and sew away.



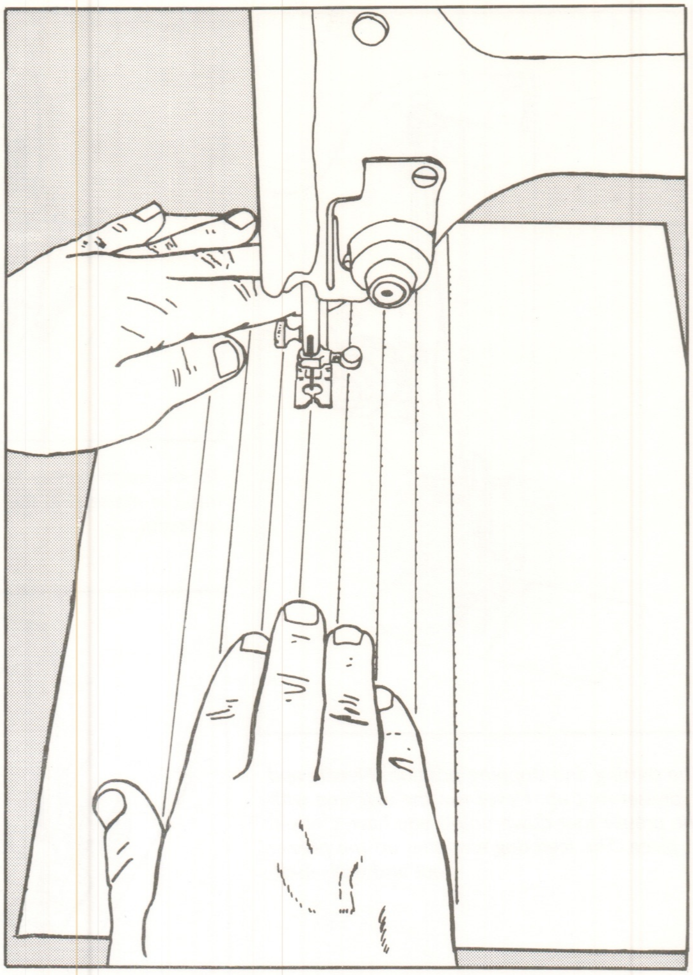
When using one hand for close work, (right hand turns hand wheel slowly) the thumb and middle finger hold the cloth flat while guiding it along.



Most work is done with both hands controlling the material as it passes under the needle. Although sewing paper without thread doesn't require this position, you should use it on the paper exercises just to get into the correct habit.

Exercise 3
Straight Stitching

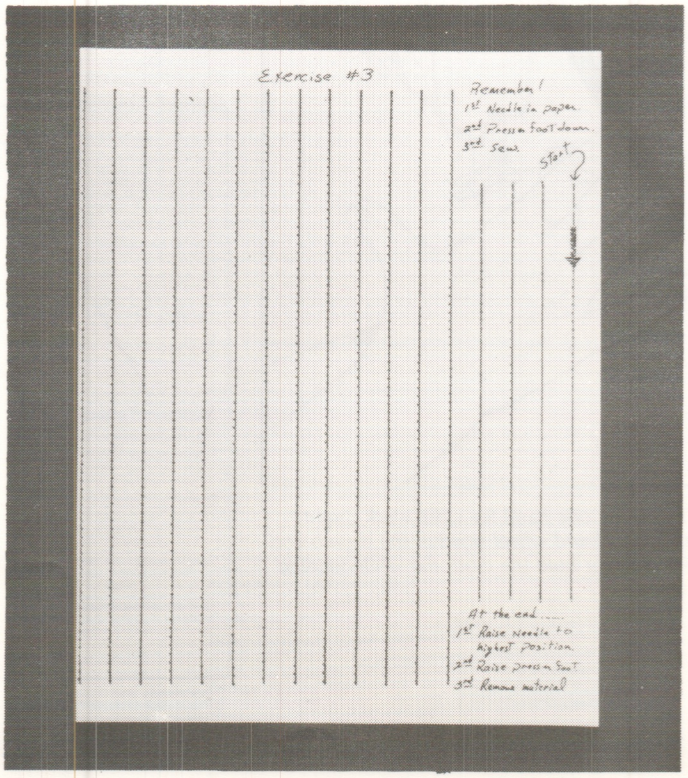
After learning the general theory and function of your sewing machine you still have to learn how to make the thing behave. That takes practice, don't be shy about doing enough. During this and the next two exercises, you'll practice guiding sheets of paper through the machine without thread. This will give you a pretty good feel for controlling the feed before you start worrying about tension balance of the thread. When you stitch, concentrate on keeping your stitch straight down the line and on stitching at an even, moderate pace without erratic speeding up or slowing down. Practice on the sheet labeled Exercise 3. If you need more practice, use lined notebook paper. You're doing good enough if you can stitch at a steady speed and have all the needle holes touch the line (exact centering isn't required).



Use both hands to guide the paper, left behind and right in front of the needle. Try not to stitch on your finger, it makes a mess.

Procedure

1. Remove top and bottom threads from the machine.
2. Set the stitch adjustment to 7-8 stitches per inch.
3. Start at the point marked "Start" and stitch down to the end.
4. Continue the process across the sheet until it's full.
5. Practice until you've got it under control.



Exercise #3

Remember!
1st Needle in paper.
2nd Presser foot down.
3rd Sew.

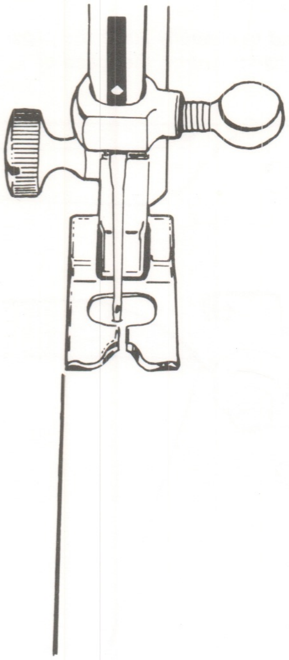
Start

At the end.....
1st Raise needle to highest position.
2nd Raise presser foot
3rd Remove material

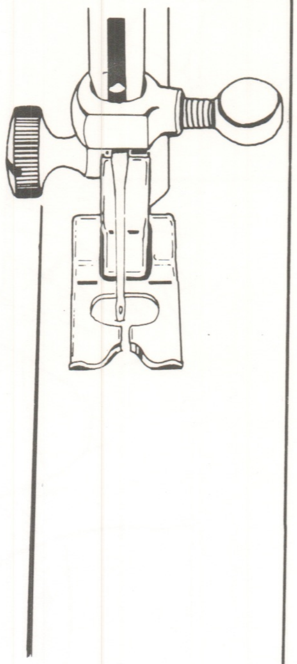
A properly completed Exercise 3.

Exercise 4
Parallel Stitching

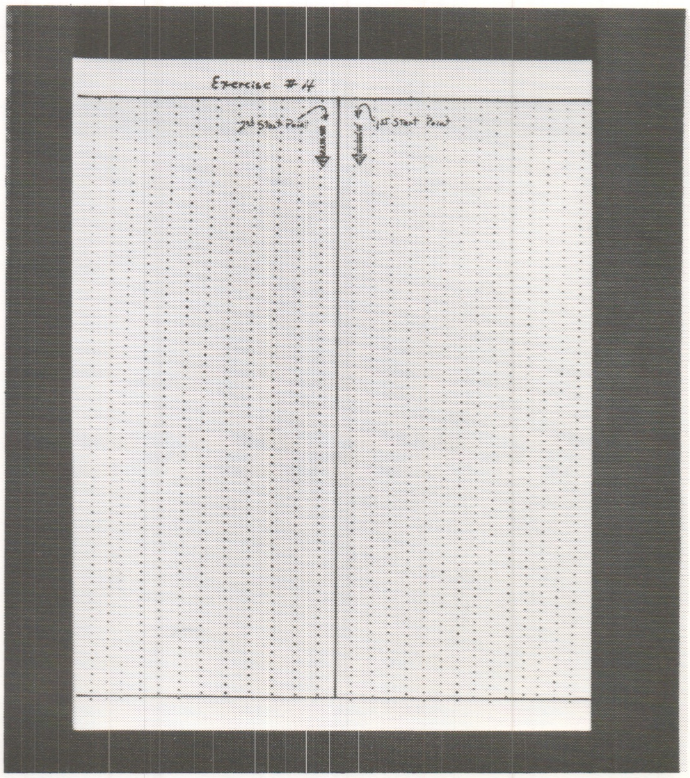
In this exercise, you will practice stitching along side a line instead of right on it, as before. Since all the seams in your canopy have two rows of parallel sewing, you'll do quite a bit of this, so work on getting it right. The secret is not to watch the row you are sewing, but to watch the row that you are using as a guide. Watch carefully its relation to the nearest edge of the presser foot and keep that distance constant. With a little practice, you'll be able to sew two rows so straight that no one could tell that you were using a single needle machine instead of a commercial double needle.



First sheet has guide row lined up on edge of presser foot.



Second sheet has guide row lined up about ¼ inch from edge of presser foot.



Procedure

1. Machine without thread, stitch adjustment at 7-8 per inch.

2. Using the Exercise 4 sheet, line up the left edge of the presser foot on the center line at the "1st Start Point" and stitch from the top horizontal line to the bottom one. Next, line up the left edge of the presser foot with the row of stitches you just made and stitch from top to bottom. Repeat this all the way to the right side of the paper.

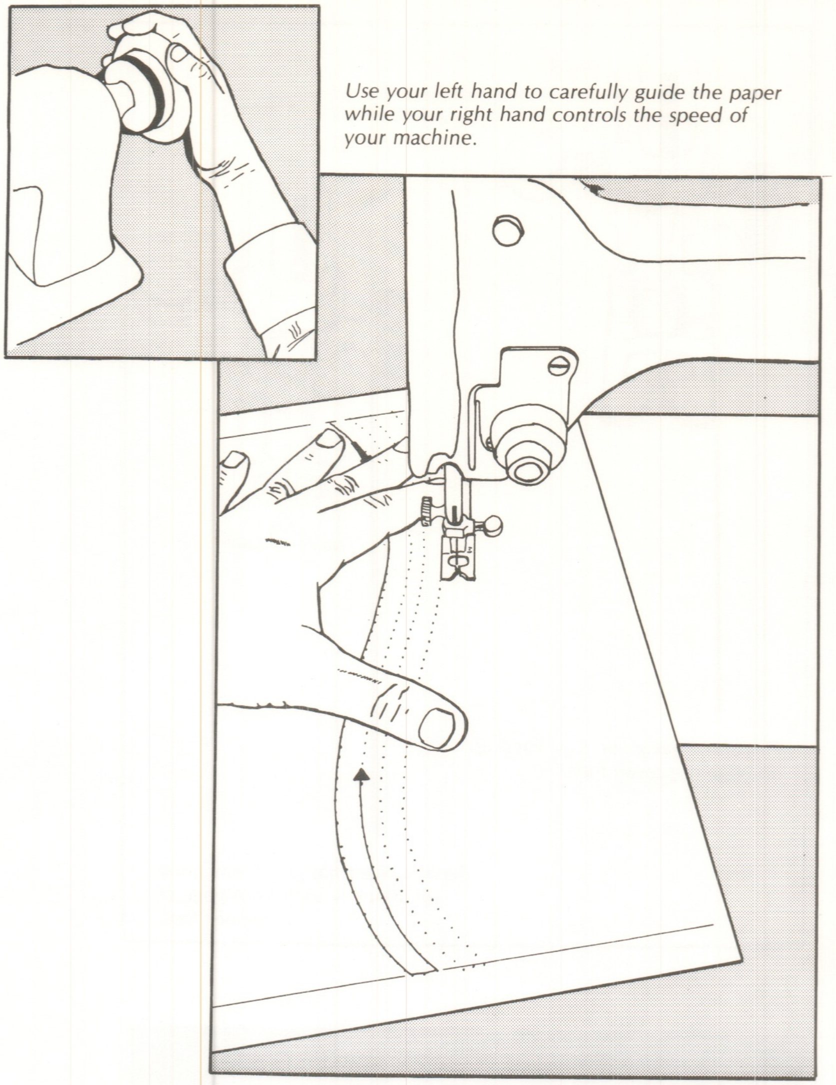
3. Now go to the "2nd Start Point" and align the right side of the presser foot along the center line and repeat the exercise, working to the left side of the paper.

4. On another sheet, repeat the entire exercise, but this time, move over about a ¼ inch and practice stitching without having your guide row right on the edge of the presser foot.

Exercise 5
Curved Stitch Path

This exercise encompasses a more difficult chore, the stitching of constantly curving parallel lines. This is good preparation for the more detailed work you'll have to do on your canopy. The trick is to use one hand to control the material and the other to control the speed of the hand wheel. You can't sew very far at a stretch this way but you can sew accurately. Gently rest your right hand on the hand wheel and allow the wheel to turn slowly as you press on the speed control. Use your hand as a slip clutch, tightening up a bit if the machine starts going too fast, loosening up if it slows down too much.

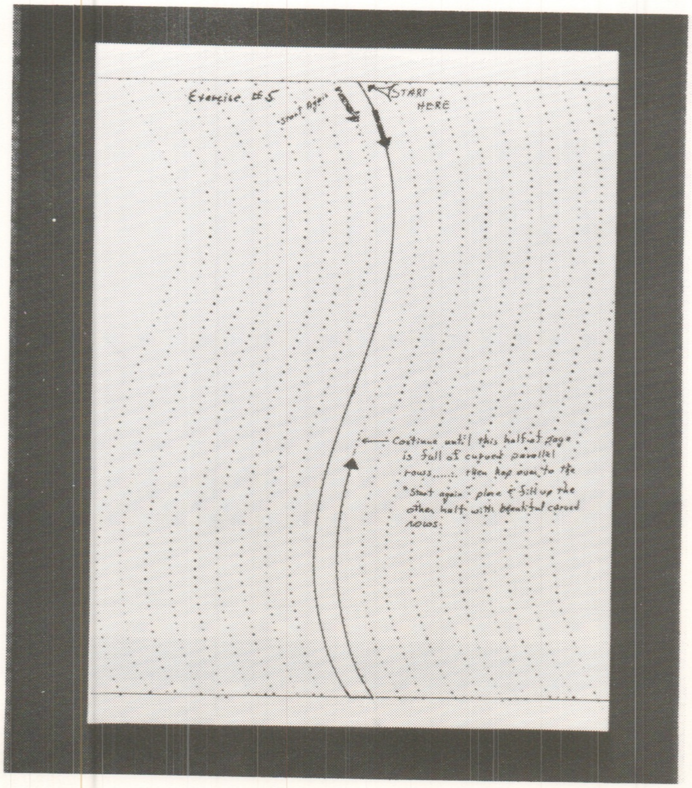
Here you'll be stitching back and forth, so you'll be pivoting with the needle in the material. When you're ready to turn the paper, stop with the needle in the paper, but, on its way back up. Raise the presser foot and turn the paper. Lower the presser foot and continue stitching. It's important that the needle be coming up when you stop so that the hook has already caught the loop, otherwise, you may, in moving stuff around, cause the hook to miss the loop and drop a stitch.



Use your left hand to carefully guide the paper while your right hand controls the speed of your machine.

Procedure

1. Set your machine up as before.
2. Starting at the "Start Here" point on an Exercise 5 sheet, stitch along the curved line in the direction of the arrow. At the bottom, pivot on the needle, take a couple of stitches, pivot again and continue up the line. Go past the little arrow at the end of the line and continue on, using the previous row as a guide. At the top, pivot as before and continue back down. Go back and forth until you run out of paper.
3. Once that's done, go to the "Start Again" point and repeat the exercise on the other side of the paper, using as your guide, the line down the center. Continue back and forth until the sheet is full. Repeat the exercise until your sheet looks like the sample below.


Exercise #5
"Start Again"
START HERE
Continue until this half of page is full of curved parallel rows...... then hop over to the "Start again" place & fill up the other half with beautiful curved rows.

Properly completed Exercise 5.

Exercise 6 Feeding Nylon Under Tension

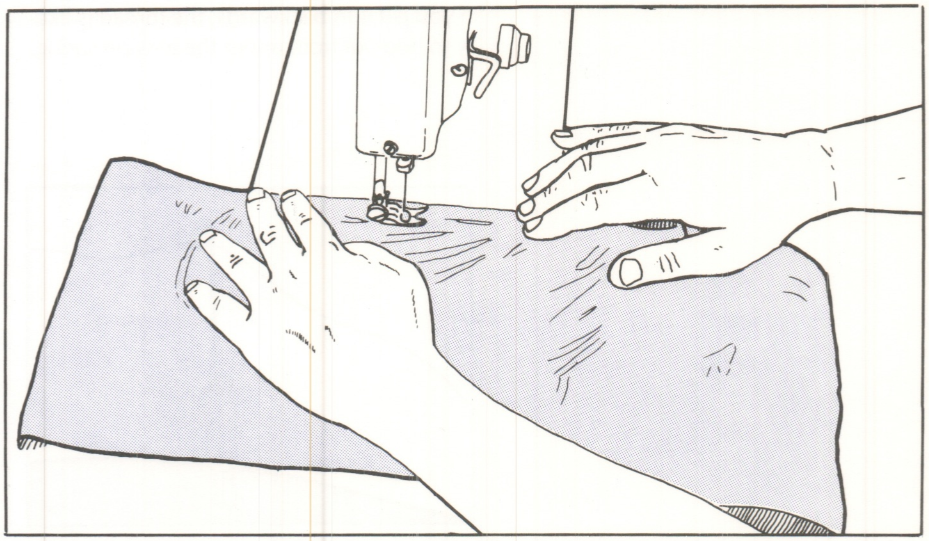
This exercise will give you practice guiding nylon under the needle. Again, we won't use thread so you can concentrate on control of the fabric. It is best to hold the material so that the line of tension between your left hand, the needle, and your right hand is straight. If you're not watching, it's easy to pull the finished seam off to the side instead of straight away. In this exercise, you'll run a length of material under the needle with the presser foot **up**. There is a chance that you could break a needle during this exercise if you pull the fabric too hard. Be sure to use one of your #18 needles, it is stout and hard to pull off center far enough to hit the throat plate and break. However, wear your boggie goggles or safety glasses just in case.

Procedure

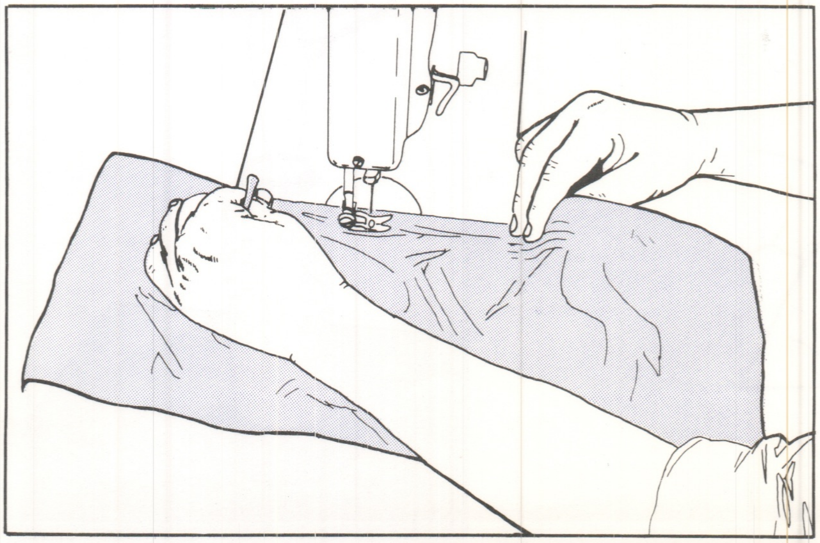
1. One of the long pieces of nylon scrap in your kit has a line drawn down the middle, use this piece. Set your stitch length at 7 stitches per inch.

2. Place this piece under the needle, presser foot down and sew to the end using the tensioning method described earlier. Stay on the line. When you stop to regrip the cloth every foot or so, leave the needle down in the cloth, this keeps it from slipping out of position. Practice with both hand positions you see below. Concentrate on a smooth even stitch speed.

3. Repeat step 2, except, this time leave the presser foot up. Now you won't have the presser foot helping you keep the line under the needle and you'll have to do it all yourself. This is the time you're most likely to break a needle, so wear your goggles. Work on moving the cloth at the speed you did earlier when the presser foot was moving the cloth. Run your machine at the same speed. Repeat this until you are running the strip through the machine at the same general rate that you do when you have the presser foot down. And keep that needle hitting on the line.



With this position, both hands are pressing the cloth against the table as they pull tension at the same time. As you sew, the whole business slides along until your right hand is at the presser foot. Stop with the needle down so the cloth won't slide out while you reposition your hands for another pass.



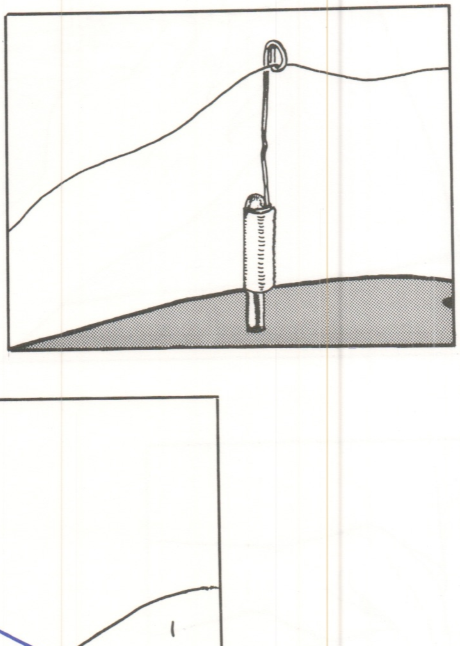
This hand position, actually gripping the cloth allows a tighter stretch and in some instance more control. Tighter stretches are usually required on bulkier seams. Use whichever position or combination of the two you find gets you the best results. There are no rules.

Exercise 7
Threading your machine

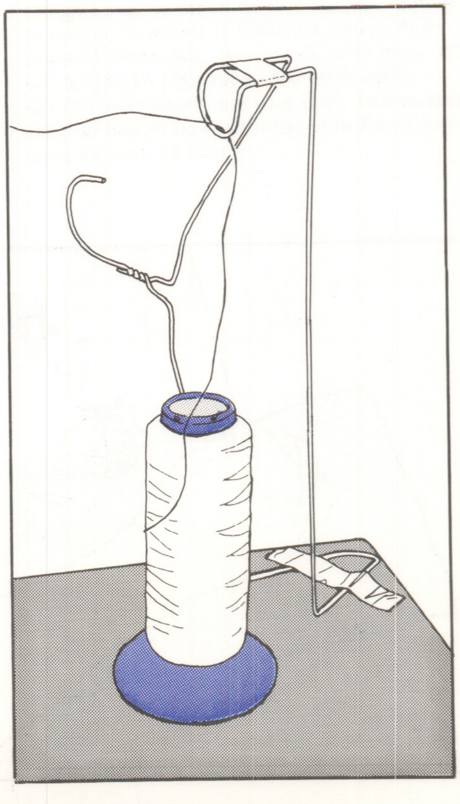
Now it's time to thread your machine and start sewing. First, wind fresh thread on all your bobbins. The thread in your kit is nylon, size E, type II, class 1, subclass A, which means that it is a strong (8.5 lbs tensil strength), bonded (a little resin mixed in to make it a little stiff and keep the microscopic strands together) low elongation (stretches less than normal) thread. **Under no circumstances should you ever use any other thread on your canopy.** You should have a dozen or so bobbins that you'll wind up all at one time so you don't have to mess with it in the middle of a seam. Your bobbin winder will wind the bobbins with a proper amount of tension, and usually will disengage automatically when the bobbin is full. If it doesn't, make sure you stop the winding before the bobbin gets too full. Place a bobbin in the bobbin case and draw the thread out through the proper slots, making sure it's under the tension spring. Each machine requires that the bobbin be placed in the case in a particular way, make sure you're doing it right. If you get it in backwards, the thread is likely to hop out from under the tension spring, usually in the middle of a critical seam.

Before threading the top thread, you must make a thread guide from a coat hanger. The thread must be drawn off the large spool from the top, not the side as with small domestic spools. This little arrangement can be placed anywhere that will allow the thread to go easily to a small loop that you have taped to the top of the spool pin on the top of your machine. As long as the routing of this thread doesn't get in your way and the thread feeds off the spool OK, it doesn't make much difference how you set it up. Thread the top thread according to the requirements of your machine. Remember, there is one right way to do this, make sure you know it.

Pay special attention to the position of the needle. Most machines have the needle go up to a stop in the needle clamp. All machines require the long groove in the needle to be faced in a certain direction. If it's backwards, the machine probably won't sew and it may damage the hook below and break the needle. Once the top thread is in place, lift out the bobbin thread and you're ready to go.



Bend up a coat hanger to make a thread guide as below. Tape the base of your guide down to hold it steady and close the upper loop with a bit of tape to keep the thread from jumping out. Tape another small loop (paperclip bent to shape) on the spool pin to carry the thread from your thread guide to the stitching mechanism.

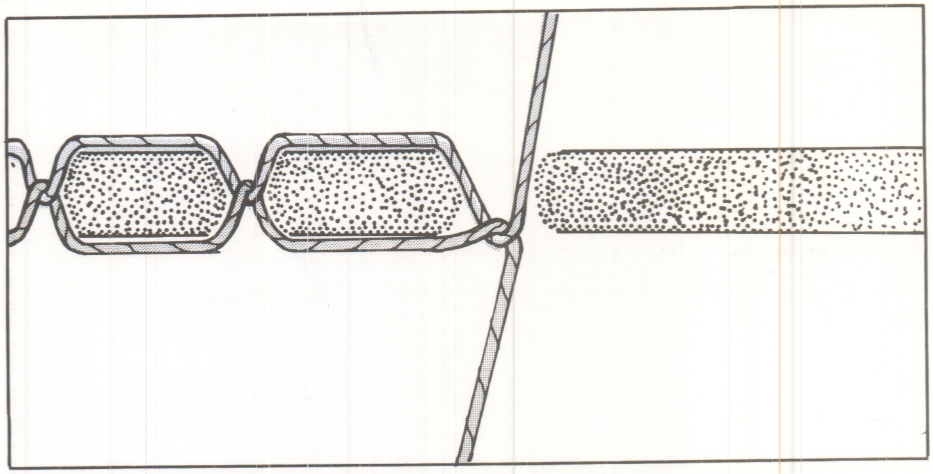


To keep your bobbins from unwinding before you use them, pull the loose end, causing the last turn or so to bury itself in the body of the thread. When placing the bobbin in the bobbin case, pull this buried part back out.

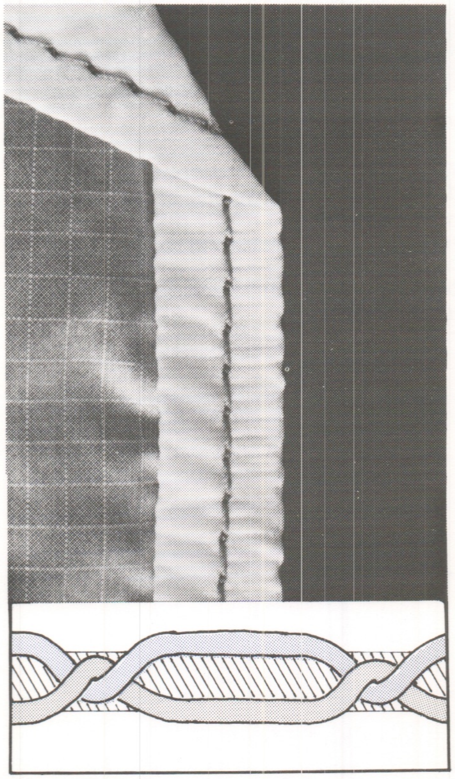
Stitch Balance

When the tension on the top and bottom threads is even, the interlocking loop will be centered in the cloth. If one thread is pulling harder than the other, the loop will be pulled in that direction, resulting in an improper stitch. When the tensions are right, the top thread tension adjustment will allow the top thread to slip through the tension disks just as the loop reaches the middle of the cloth, thus keeping the take up leaver from pulling the loop any higher. Usually, once your bobbin tension is properly adjusted, you won't have to worry much about it.

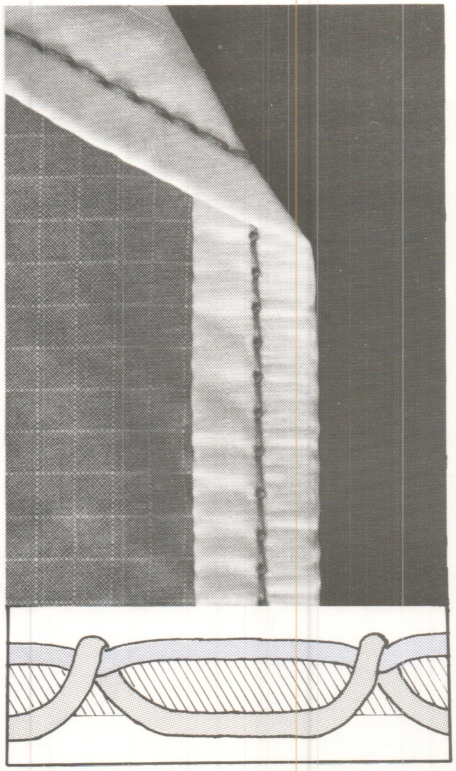
Depending on the thickness and tightness of the material you are sewing, changes in adjustment will be done with the top thread tension adjustment. Sewing two layers of canopy fabric won't require much tension on the top thread, while sewing the suspension lines into your canopy will require more. You'll tighten the top tension to enable the machine to pull the thread into this thicker section. It is important to pay close attention to thread balance. When you have it right, your stitch will look pretty much the same on both sides of the cloth and will give you the maximum strength from the seam.



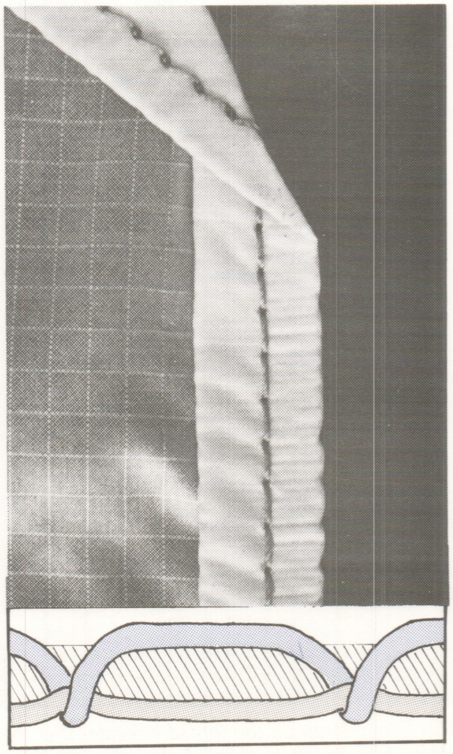
As the top thread pulls the loop to the center of the cloth, the top tension adjustment will let the thread slip through a little, preventing the take up lever from pulling it any higher.



This properly balanced stitch has the loop centered in the cloth. You can just barely see the loop down in the cloth when you look from either side.



The top tension is too tight, pulling the loop all the way through the cloth to the top side.

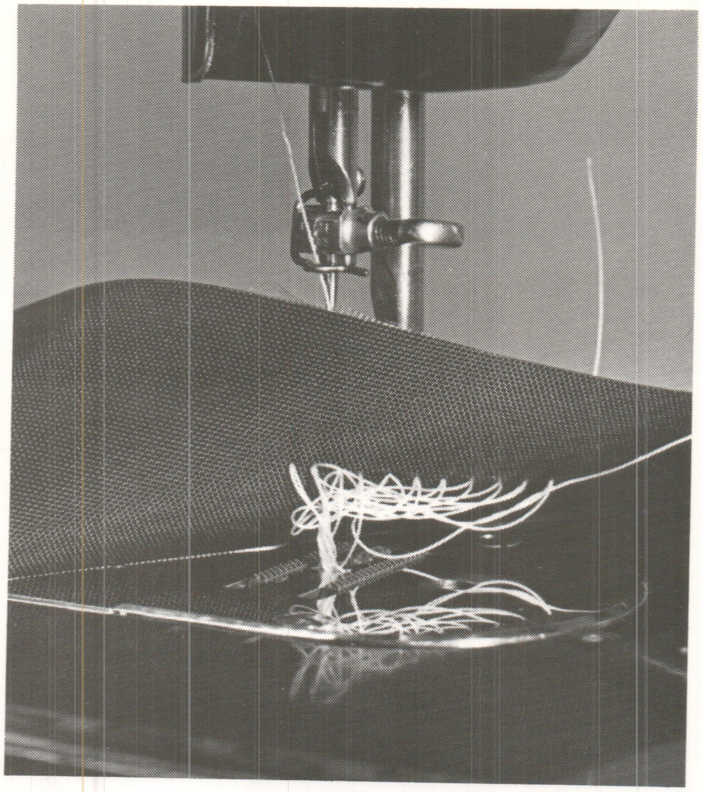


The top tension is too loose and is not pulling the loop into the cloth. The loop can hardly be seen at all from the top side but is plainly visible on the bottom side.

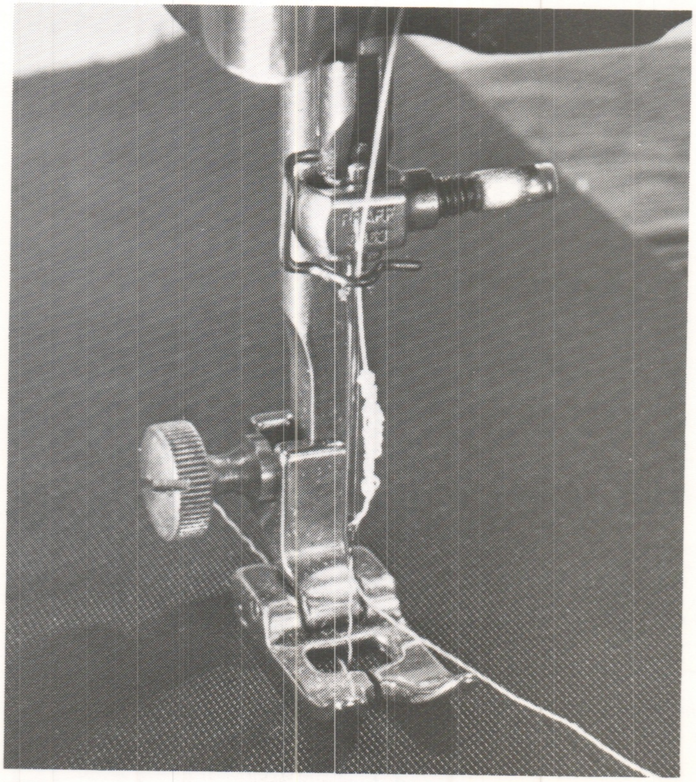
Troubleshooting

Assuming that you don't want to become a sewing machine mechanic, this troubleshooting section is limited to those things which come under the control of the operator. Difficulties which require mechanical adjustment or disassembly of the machine should be handled by someone experienced and the main reason for having theoretical knowledge is so you can tell whether you or the mechanic should handle the problem.

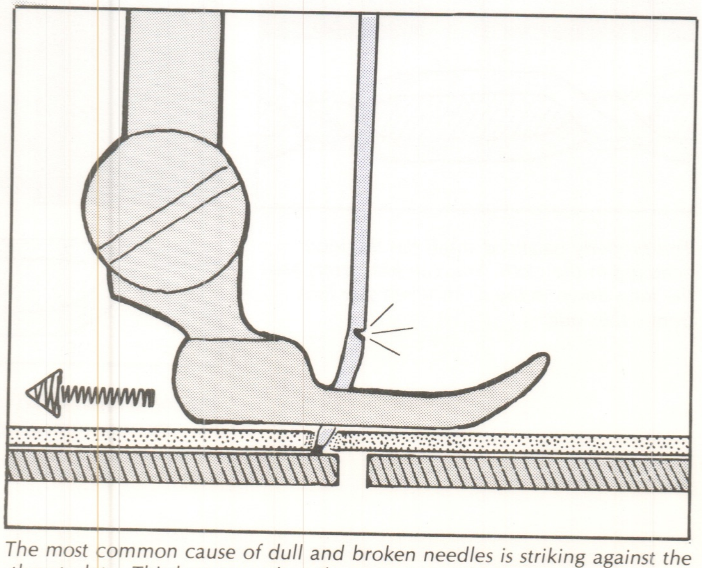
If you still can't solve the difficulty after going through this section, it's time for a trip to the shop. Remove the machine from the cabinet and take it, along with your E thread, some canopy fabric, and your size 18 needles to the shop. They will want a sample of your thread and material so they can test their repair. When you pick up your machine, have the repairman show you what he did, might as well get a little education along with your bill. Still, once you get used to your machine and are threading and handling it properly, it will very rarely give you any trouble. The good machines are extremely reliable.



A Major League thread jam. This is one of the few things that will stop your machine completely. It's caused by a sudden loss of top thread tension, allowing each stitch to stay below the throat plate. Raise the presser foot and pull gently on the cloth while turning the machine back and forth with the hand wheel. If this doesn't release the jam, you will have to cut it out with your scissors. You may have to remove the needle. Once you have it all out, take the bobbin out and clean out any loose threads remaining in the bobbin area. One little piece can keep the entire machine from turning. Rethread your machine. This is caused by a threading error usually.



This little pile-up on the thread indicates that the thread is being damaged somewhere in the machine. E thread is very strong and most domestic machines don't have the power to break it. They just chew on it. If this happens other than very, very occasionally, a trip to the repair shop may be in order. The hook may need to be repositioned to catch the top thread loop properly. But go through your check list first.



The most common cause of dull and broken needles is striking against the throat plate. This happens when the operator pulls the material too hard; as the needle hits the material, it is pulled away from the hole and hits on the edge.

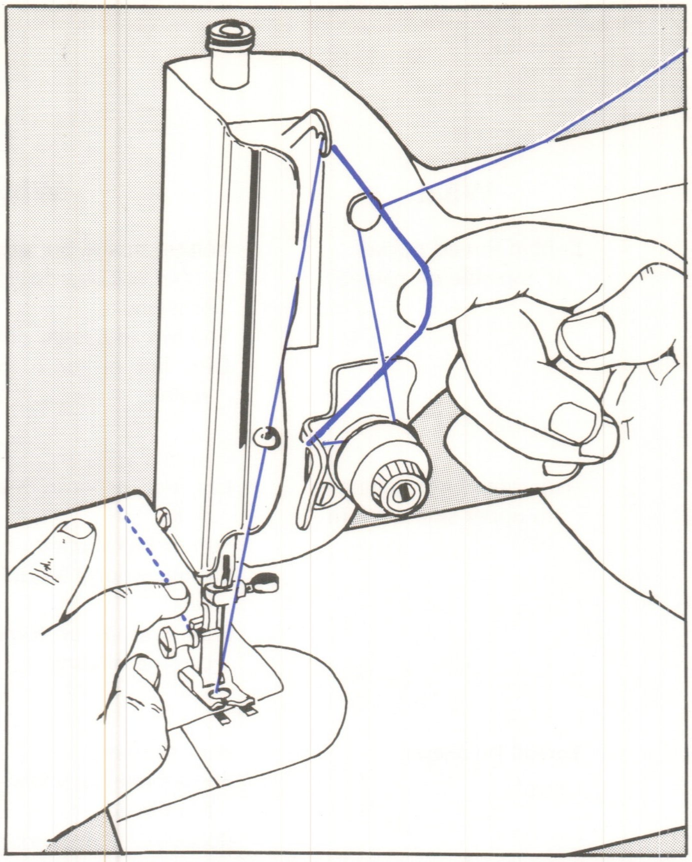
What	Why
Bobbin thread pulled to top side of material	Bobbin thread not under tension spring Bobbin backwards in case, causing erratic tension Top thread caught or tangled Dirt, lint or loose thread under tension spring
Top thread not pulling to upper side of cloth	Lint, dirt, or loose thread between tension disks Top thread slipped out of tension disks Bobbin wound too full, binding in bobbin case Bent bobbin or foreign matter in case, causing binding
Thread breakage	Bent needle Bobbin tension screw protruding, catching top thread Bobbin case not properly seated Wrong needle
Needle breakage	Operator pulling material too hard Wrong needle or needle bent or improperly set, causing it to be hit by hook
Uneven stitching	Too little pressure on presser foot Irregular pulling of fabric by operator Too much tension on top and bottom thread, restricting action of feed dog.
Skipped stitches	Needle bent Needle set backwards Needle threaded backwards
Material scuffed on bottom	Too much pressure on presser foot Operator feeding material to machine slower than feed dog is pulling
Machine turns hard or noisily	Loose thread jammed around bobbin area Lack of oil (especially in bobbin area) Tension too tight Bobbin winder engaged
Machine jammed	Thread jammed around bobbin area Needle bent and caught by hook

General Procedure

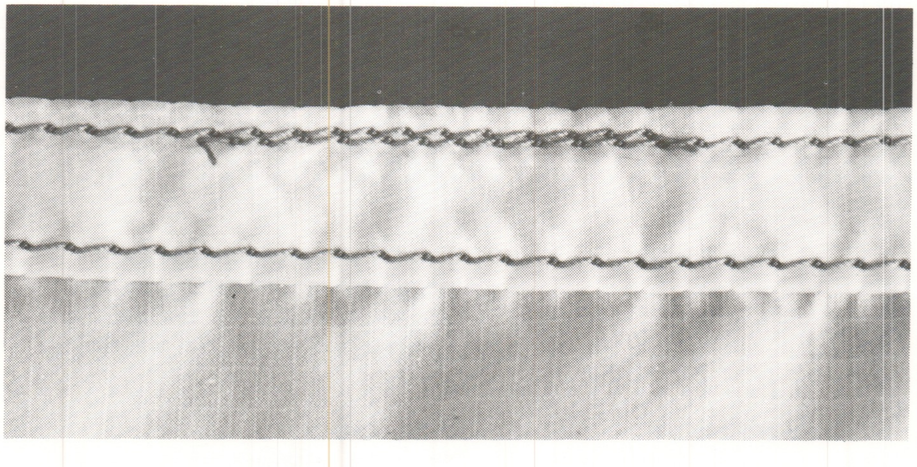
Most difficulties can be cleared up right away by the following procedure

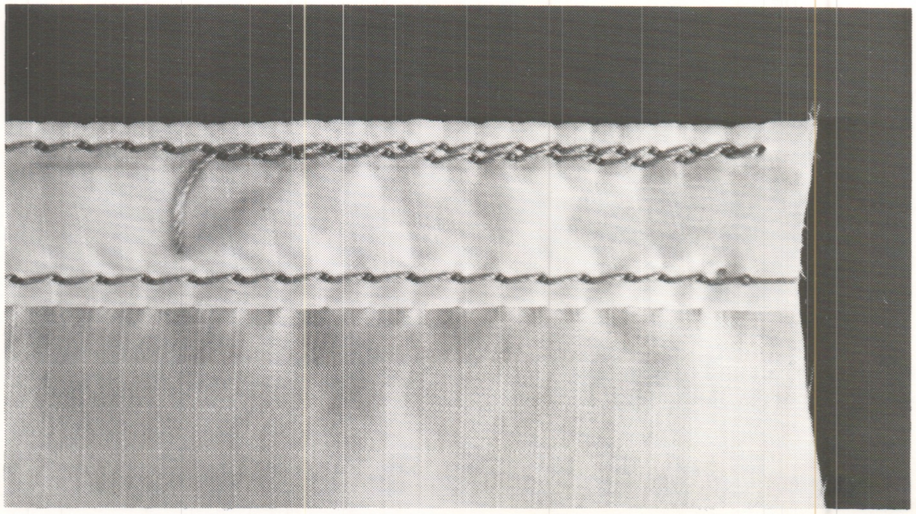
1. Trace top thread from spool to needle, insuring:
   - no tangles or catches
   - proper threading (between tension disks)
2. check needle for proper set and threading
3. remove bobbin case, insure
   - bobbin installed in correct direction
   - thread under tension spring
   - case reinstalled properly.

All machines are designed to release the tension on the top thread when the presser foot is raised so the material may be withdrawn easily. Sometimes this doesn't work with the thicker E thread or doesn't work at all. Pulling the thread out under tension doesn't hurt anything except it might bend the needle. A bent needle will cause trouble, so if your machine doesn't release properly, use this procedure. After the last stitch, raise the needle to its highest position, hold the material firmly with your left hand and pull some slack between the take up lever and the tension disks. Then remove the material in the normal manner.



Sometimes you'll have to restart in the middle of a row, usually because you ran out of bobbin thread before you got to the end. In this case, back up 1½ to 2 inches and restart. This maintains the continuity of your stitch.

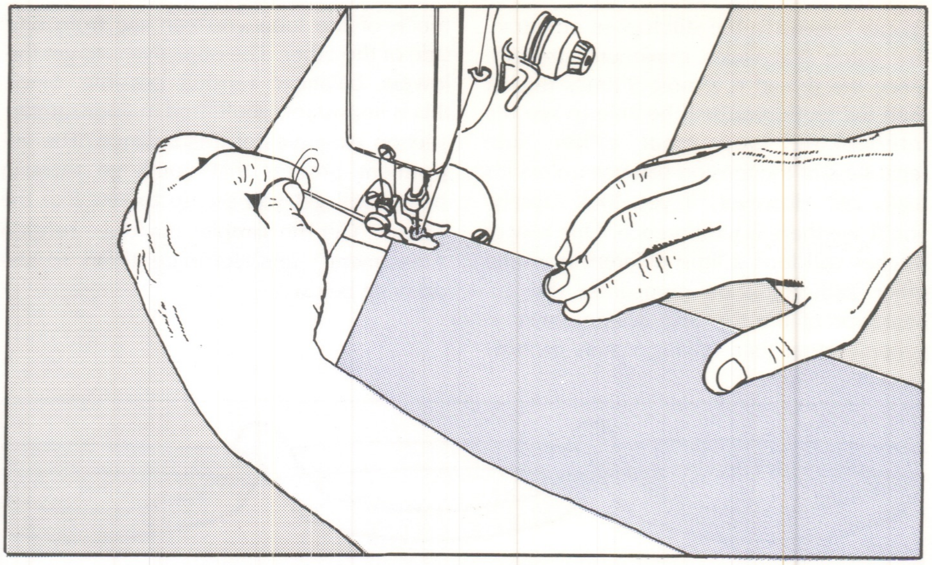




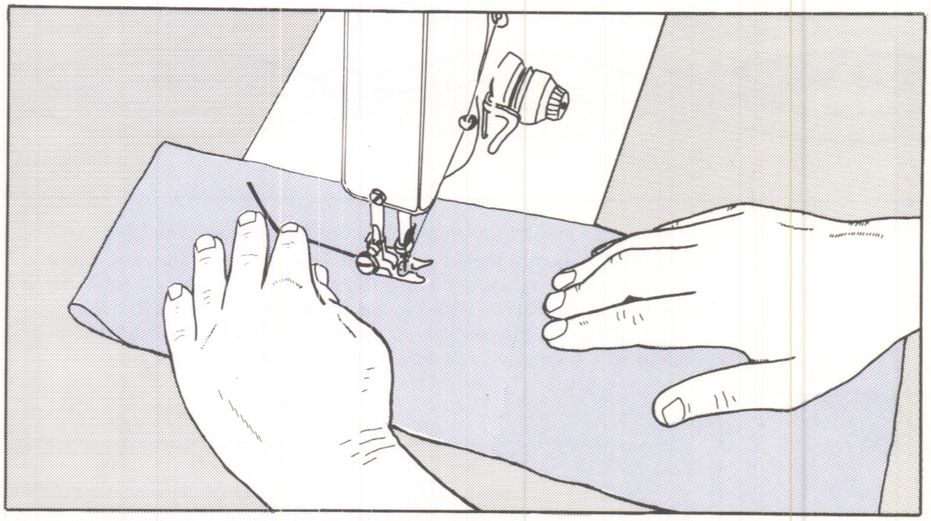
This photo illustrates, on the upper row of stitches the standard method for locking a start or finish of a row of stitching. Sew to the end of the cloth, pivot around on the needle, and sew back along the row 1½ to 2 inches to secure the stitching. Reverse the process for starting. The lower row shows an end without locking. This is done when the end of the seam will be secured some other way, like sewn into another seam.

Starting and Stopping

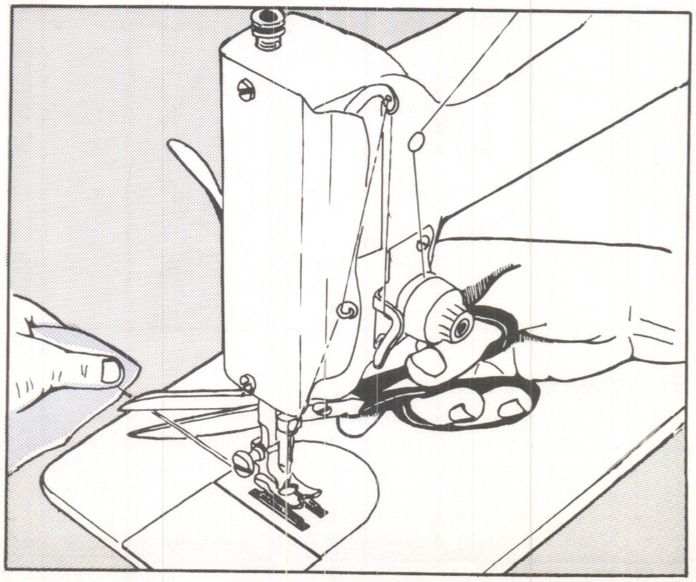
Get in the habit of starting and stopping your stitch run in the same way every time. A seam, well started, is easy to keep straight, but if you get a poor start it'll be hard to straighten out even if you don't have to start over. Make sure you have your pieces aligned properly, and hold the loose ends of the thread for the first few stitches to prevent a snarl. Run the first few stitches slowly to make sure your alignment stays where you want it and the stitch row is properly positioned. When stopping, slow down near the end of the seam and make sure your alignment and stitch stay positioned to the last stitch. Raise the needle to its highest position, raise the presser foot, pull the material straight back and cut the threads.



Starting out, the loose ends of the threads can tangle with the first few stitches and make an ugly mess, or they may be pulled beneath the throat plate and cause a jam that will stop the machine. To get started on the edge of the cloth, place your needle, lower the presser foot, grasp both top and bobbin threads and pull gently as you start to sew. This keeps the threads from getting tangled. After 4-5 stitches the threads may be dropped and the material guided in the regular manner.



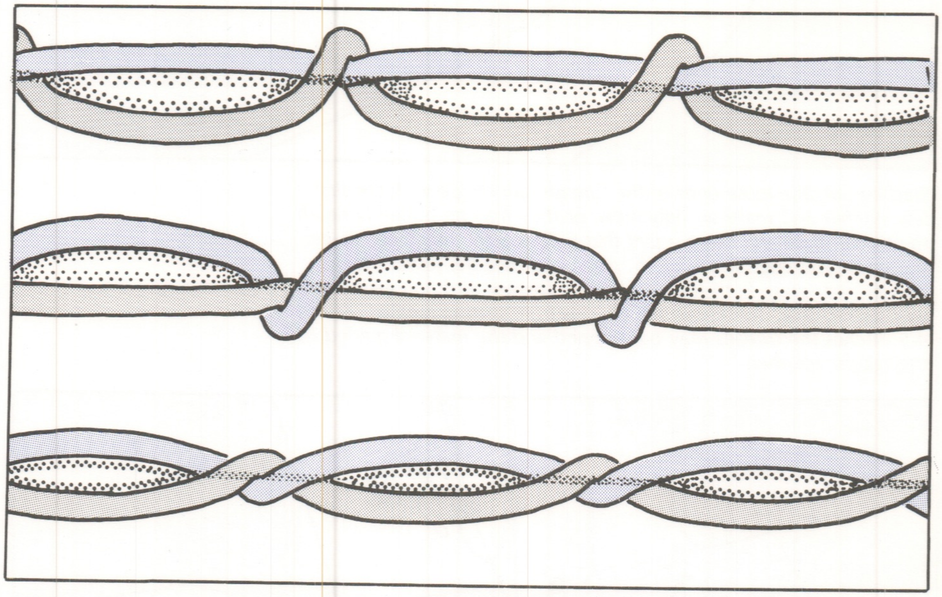
When starting in the middle of the piece, hold the top thread down behind the presser foot to prevent it from being drawn into the stitch. The bobbin thread underneath should be back out of the way also.



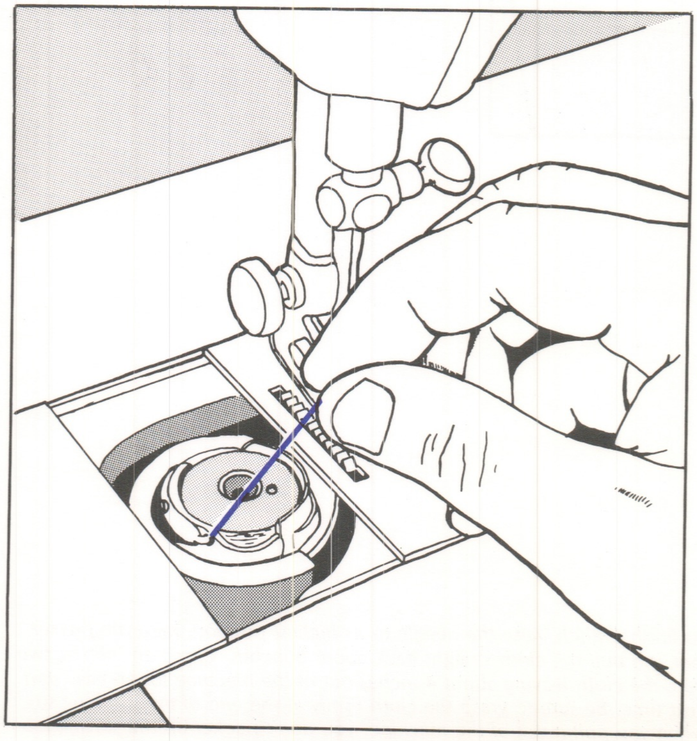
To finish a stitch, raise the needle to its highest position, raise the presser foot and pull the cloth straight back about 6 inches. Clip it an inch or two from the cloth leaving about 4 inches out of the machine for an easy start next time. Be sure to grasp the cloth firmly at the end of the stitching so when you pull it out of the machine, you don't pucker up the sewing job.

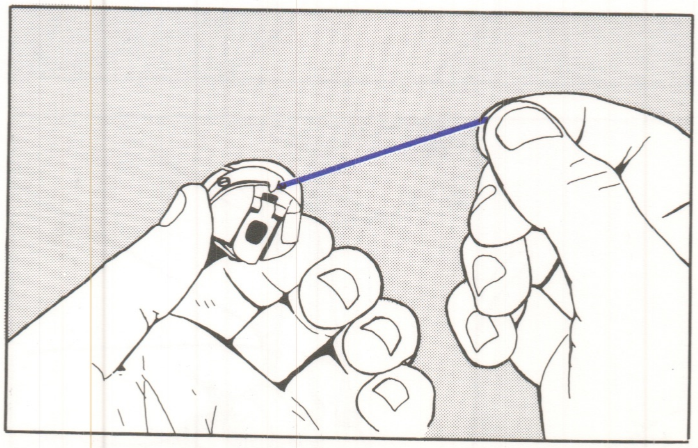
Exercise 8 Adjusting Tension

Proper tension in the stitch gives an attractive stitch that yields maximum strength. Since the thread is almost 5 times thicker than the cloth, you will be able to see the interlocking loop from either side regardless of the tension balance unless it's really off. However, if you look closely, you'll see there is a difference. One row of stitches will look a little different from the other and you'll be comparing the appearance of the top and bottom rows in general rather than relying mainly on how much of the loop you can see from one side or the other. The objective is to get the lowest, balanced tension possible. Since this is important, you'll find in your sample section examples of this balance. The adjustment process that you'll go through below will get you set up to sew like the sample. Get the samples marked "Tension Adjustment" and compare them to the drawing below.



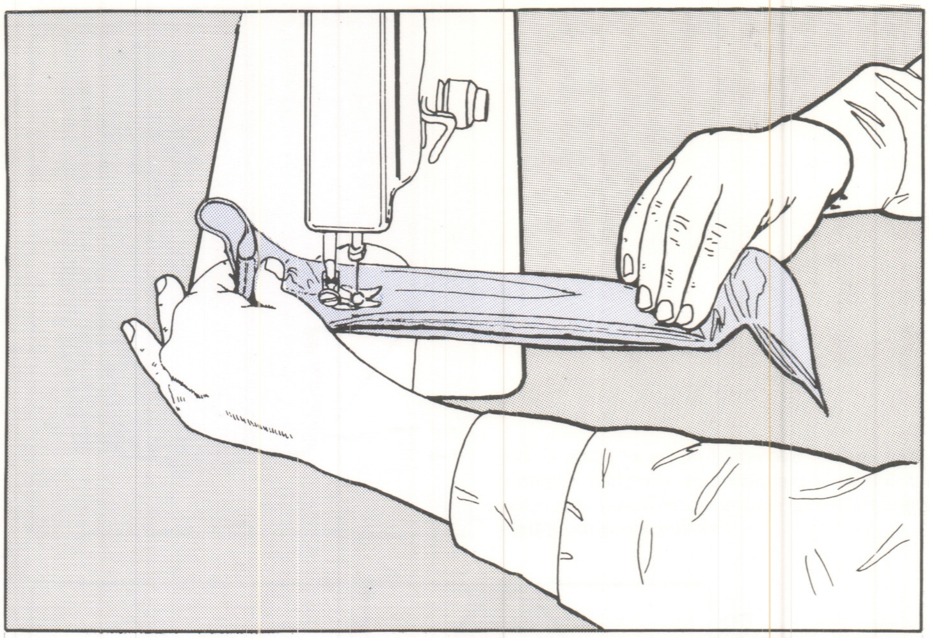
The sample marked, corresponds to the top drawing. The cross sectional view shows the top thread pulling the loop too high. The next drawing, corresponding to sample number 2 shows the opposite condition. Sample number 3, the bottom drawing, has tensions in balance. Note that although we say top too tight or too loose, actually, the bobbin tension could be too loose on number 1 and too tight in number 2.





Procedure

With a full bobbin in the bobbin case, reduce the lower tension by backing off the little adjustment screw on the side of the case. Pull on the thread as you go, adjusting the tension so there's a minimum of drag on the thread. Watch out for this little screw, if it comes all the way out and falls, it will evaporate before it hits the floor, at least I never can find them. Do not back the screw out so far that it sticks out, it will catch on the top thread as it goes around the bobbin case.



Procedure

Cut a four foot length of your scrap nylon and fold it twice, longways giving you a long piece of material 2 - 3 inches wide and four plies thick. Set your top tension adjustment in about the middle of its range and sew on this folded piece a foot or so. Check your stitch and make whatever adjustments that appear necessary. Continue this sew and adjust process until you get the stitch balanced. Make a note of the setting or mark it on your machine so you won't forget. This setting is usually OK for anything from two to four or plies of fabric. Thicker sections may require a little more top tension. Each time you start a special sewing job on your canopy, you'll sew a short sample to adjust tension before you sew the real thing.

Adjustment Notes:

When the stitch is properly tensioned and balanced, both will look the same with the loop centered on the fabric and top and bobbin stitches both having a very slight 'S' shape. If the loop appears centered but the bobbin stitch has a much more pronounced 'S' shape than the top, the overall tension is too loose. Tighten the bobbin tension and try again, adjusting the top as required. Continue this process until both sides look the same with the loop centered.

Once you get this done, the bobbin tension will usually be fine for the rest of your canopy sewing, while you will adjust the top tension depending on the section you're sewing.

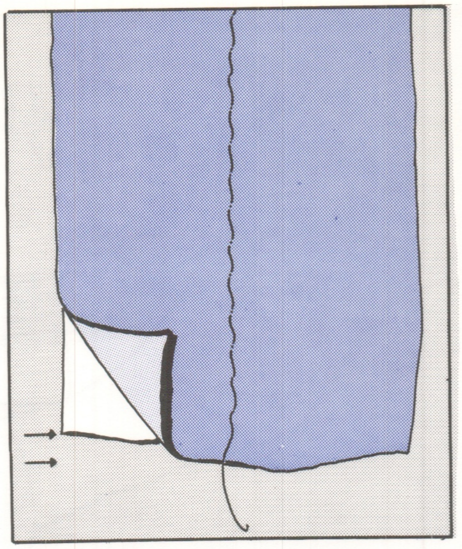
There is a little trick you can do to increase the top thread tension greatly on the machines which have the round tension disk system (as do most older types). If you can't get enough top tension when you're sewing a very thick section, wrap the top thread around the tension disks twice instead of just once. This will enable you to increase the tension range of your machine considerably, and you'll find that you have to back out the tension adjustment quite a bit to get to the tightest point you were at before. Don't do this unless you need it for a specific job.

Sometimes you have to stretch the fabric fairly tight for some reason and when you do, it will be harder for the top thread to come up through the tightly stretched cloth. In this case, you may ahve to increase your top tension more than usual for this particular job.

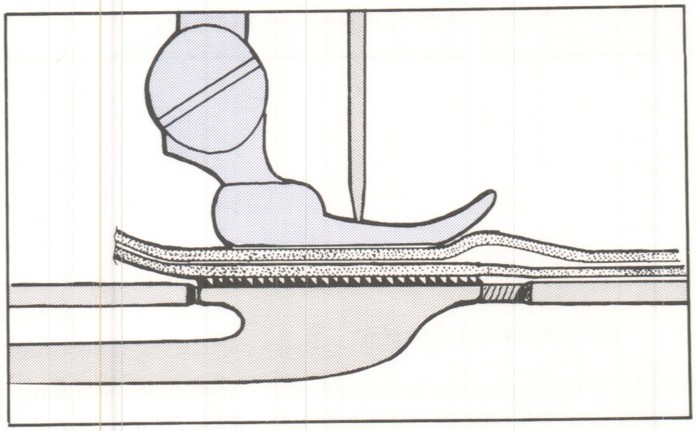
Ending Up Straight

When two pieces of material are sewn together, they can come out uneven at the end although they were started even. Two things cause this. First, if the presser foot is adjusted too tight, it will press hard on the top layer of fabric and retard its motion through the machine. The grip of the feed dog will pull the bottom layer through at a normal rate and the bottom layer will appear to creep under the top layer. Your objective is to have the presser foot tension enough to keep the cloth from sliding around, but not so much to cause differential feeding of he work.

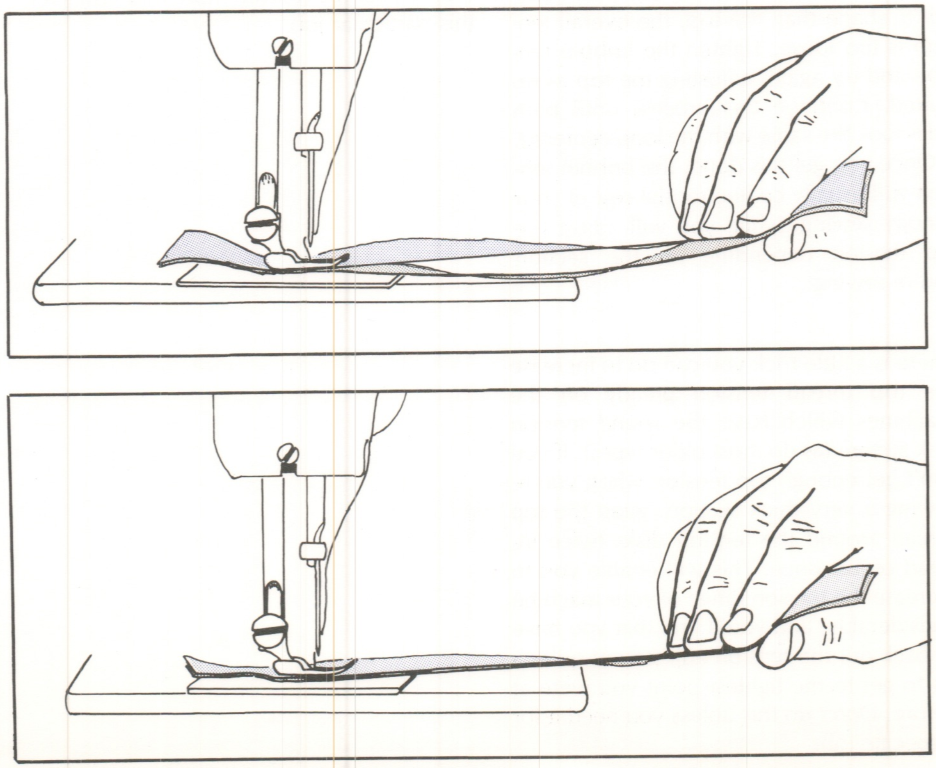
Secondly, if you stretch one piece tighter than the other, it will go together this way and your ends won't come out even. It is not possible to stretch the material very much without pulling pretty hard, but a little differential stretching over a 10 foot seam will show up at the end. This is the reason your canopy has the registration marks every few inches, if your material is creeping or stretching unevenly, you'll be able to see it right away and take corrective action (by reversing the stretch and sewing until the marks are back together).



The ends of two equal pieces of fabric come out uneven if the pieces are stretched differing amounts during sewing or because the presser foot tension is too great.



The excessive pressure of the pressure foot holds the top layer back, while the grip of the feed dog pulls the bottom layer along without restraint. The tiny difference in the feed of each stitch accumulates and the end comes out uneven.



The first example shows the bottom held with less tension than the top. The result will be a top piece that sticks out past the bottom at the end of the seam. The lower view shows even tensioning of both pieces. The result will be an even ending of the seam.

Exercise 9

Practice on Nylon

Procedure

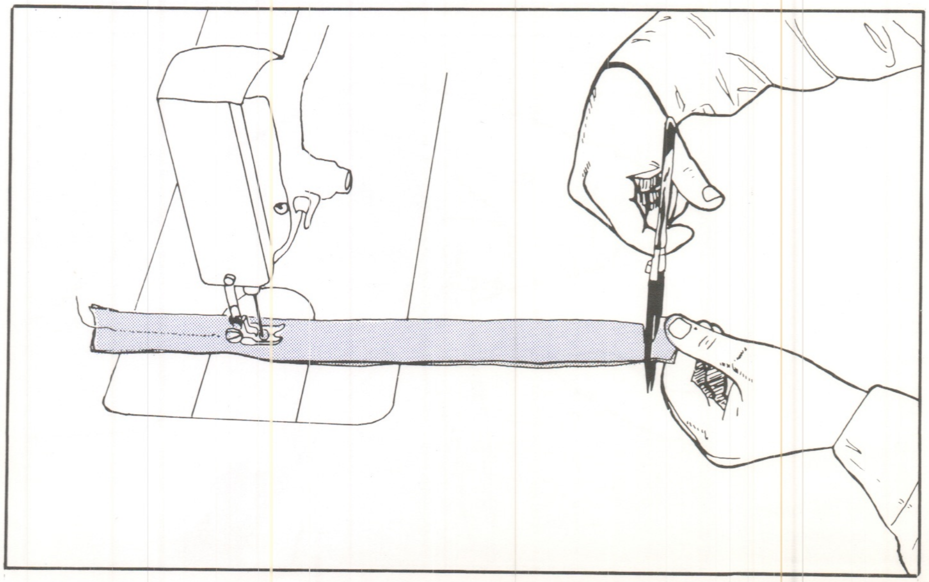
Cut several of your long scrap pieces into 3 to 4 foot lengths. Fold these longways and practice sewing on these long two ply sections. Two plies of fabric is the thinnest section you'll sew, so plenty of practice here will pay off when you start working on your canopy. Practice, practice, and practice some more. Experiment, turn in the middle of a stitch row, sew back and forth, play with it until it begins to feel easy. This is the last practice session you'll have before you start working on your canopy, so spend some time here.

Sometime during this practice, check your presser foot pressure. Generally, the more pressure you have, the easier it is to feed the material steadily. However, if the pressure is too great, it will cause the ends of your seam to come out uneven. The object is to get the pressure as tight asyou can without forcing the pieces out of alignment. Cut two pieces of fabric about an inch wide by about 18 inches long. Place the ends together and sew a couple of inches. Now, with the needle in the material to hold it secure, hold the two pieces even and cut off a bit at the free end, thus making sure the distance from the needle to the end of each piece is equal. Sew to the end and see how it comes out. If the top sticks out past the bottom piece, you may need to release some tension on the presser foot. However, the pressure should not be so loose that the material slides around under the presser foot. Once you get the pressure adjusted, practice quite a bit with it like this. If your initial work was done at a higher pressure on the presser foot, you may find that it's a little more difficult to get an even stitch at a lower pressure.

Now it's time to work on your skill. Even though you know what to do, you need time on the sewing machine to develop your ability. No amount of knowledge will substitute for experience. It's very important that you learn how to feed the material into the machine in a smooth manner so that you get a constant stitch. The trick is to sew at a moderate and steady speed. Practice until you develop a steady "cruising speed" at which you can feed the cloth into the machine smoothly.

Erratic speeds make it hard for you to hold the fabric under tension and follow the lead of a feed dog which is always changing. The result of irregular speed is a seam with areas of short, bunched stitches and others with long loping stitches. This means that your seams may be of varying finished lengths, contributing to an unsymmetrical canopy which may have a built-in turn.

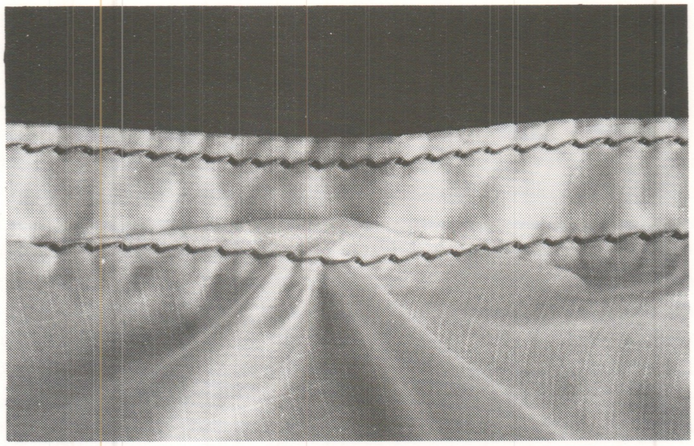
The standard stitch range is 7 to 11 stitches per inch. You should try to sew at a steady 7 to 8 stitches per inch as this will give you the least amount of seam shrinkage and as long as the shrinkage is low and constant throughout the canopy, there will be no problem. Adjust your machine for 7 to 8 stitches and check it by sewing on a piece of paper. Measure off an inch and count the stitches. Your machine must be adjusted to the length of stitch you're trying to sew, otherwise, you may be pulling the material through the machine at a smooth 7 per inch while the feed dog is scratching up the material trying to pull it through at 13 per inch.



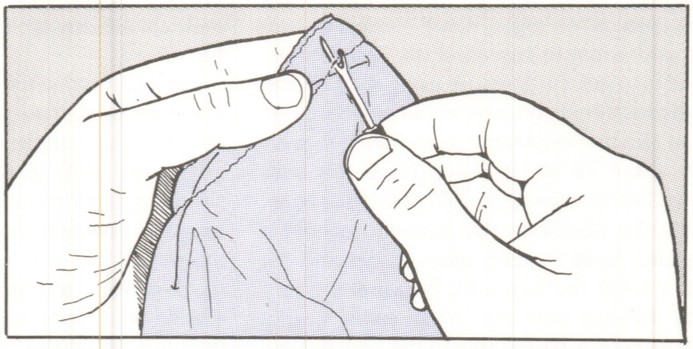
Checking pressure of the presser foot. Two lengths of fabric are sewn together a short distance and the ends cut off even. Then the pair is sewn together to the end. If the presser foot pressure is too great, the top will stick out past the bottom. Decrease pressure until this condition is eliminated. If pressure is too light, increase until the presser foot begins to shove the top piece back, then reduce pressure until the condition is eliminated.

Mistakes

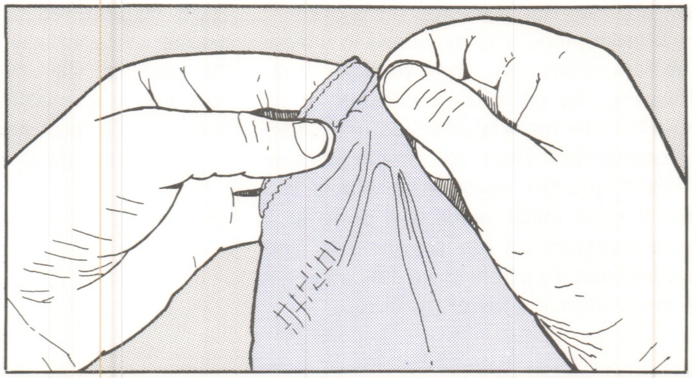
One nice thing about sewing mistakes, they can always be corrected. It's a simple matter of cutting the stitches with your seam ripper, pulling out the loose threads and starting over. Most of the time you'll be correcting the little problem you see here, accidently getting a piece of material into the seam you're sewing. You just remove the stitches, reposition the material and resew the seam, overstitching 1½ to 2 inches on both ends to secure the repair. This is the nice thing about sewing your canopy, you can't make a mistake that you can't correct. That takes a lot of the heat off.



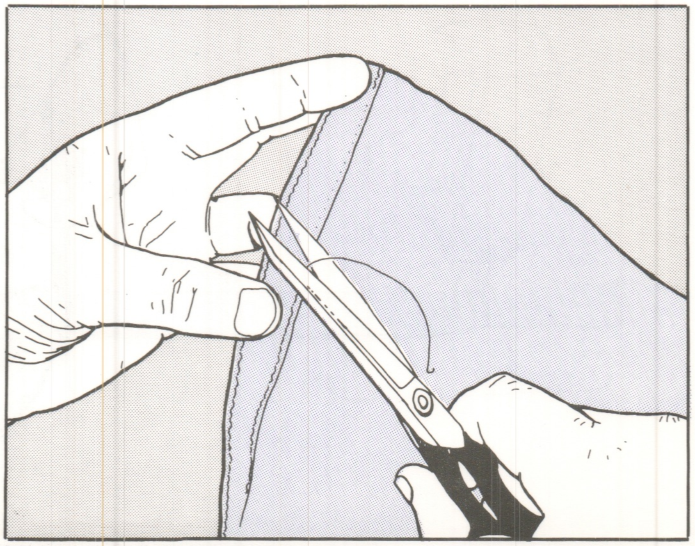
A bit of material got into the stitching of this lower seam. If this is not corrected, a rip would start here soon. Correcting this little error is simple and you most likely will have to do it a few times during your construction.



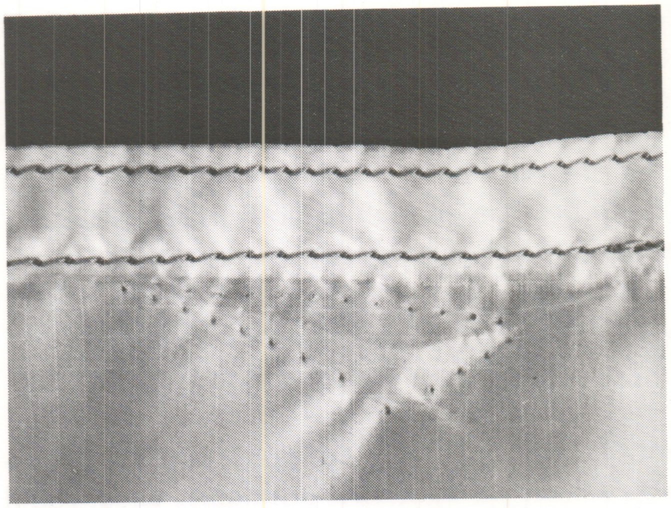
Starting just above the area to be repaired, cut every third stitch along that part of the stitch row to be removed. Cut gently with your seam ripper so as not to disturb the area of good stitching.



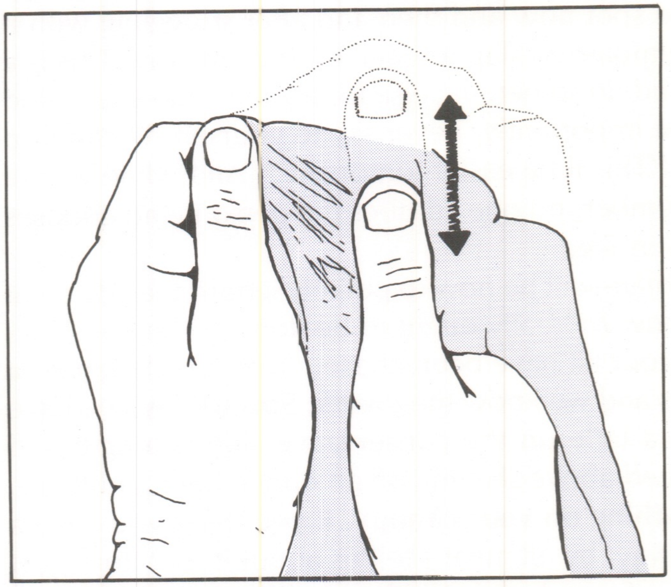
Pick out the short pieces between the cuts. A pair of needle nose pliers or a pair of tweezers makes this easier, but fingers work fine.



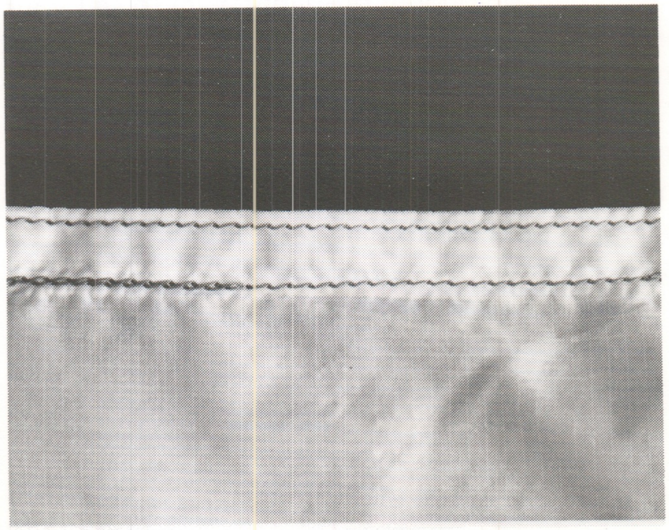
Turn the seam over and snip out the long loose thread on the other side. After the thread is removed and the material repositioned, resew with a 1½ to2 inch overlap at each end of the opened area.



After resewing with 1½ to 2 inch overstitching on each side, your seam will be back to normal except you'll have stitch holes where the old stitches were. This does not cause any problem other than cosmetic and a little hand work will solve that.



Grasp the material around the ugly place and stretch it while moving your hands up and down opposite each other. This will work the yarn threads back into their previous position and make the repair almost invisible.



A finished repair. Only the bit of overstitching tells that there was anything unusual here.

Now it's time to do a little work that you can take to the bank. If you started the skills section completely raw, you still probably won't be able to work very fast, but you can work cleanly and accurately. Speed is not important so take the extra time to do the work right. Remember the old saying, ''If there's not time enough to do it right, will there be time enough to do it over?'' The very best riggers concentrate on accuracy, not speed.

Building Your Canopy

It's most important that you build your canopy exactly as the instructions direct. You'll have to fight two problems. First, you'll come across a hard spot now and then and after struggling with it awhile, you'll be tempted to slap it together any old way. This is a good time to quit and do something else for awhile; take your mind off your work. Most importantly, never say to yourself, ''I can't do this.'' Say instead, ''This'll be easier tomorrow.'' And while you're taking a break remember, no one admires the person who chooses only the easy tasks in life.

Your second problem will be how to politely ignore the advice of your friends as to how it ''really ought to be done.'' The construction techniques in your kit have been chosen from a wide range of differing techniques and we know they work. Specifically, we have chosen techniques a little on the conservative side; strength and durability were placed above shaving off an ounce here and there. **Do not change anything on your canopy.** If you think you have a significantly better way, by all means tell us about it, but don't just try it out on your kit. Someday you will probably want to sell your canopy and we want you to make big bucks on the deal. To help, we'll send to anyone who asks, a free guide, ''How to buy a used Lone Star Canopy.'' This will be the same as your final inspection with instructions on how to examine the canopy. Your buyer will be impressed when he sees that your canopy is built to the exact factory specifications and you'll be able to get a higher price.

Now, turn to the general assembly sequence in the appendix and familiarize yourself with the overall project and then get started.

Suspension Line Preparation

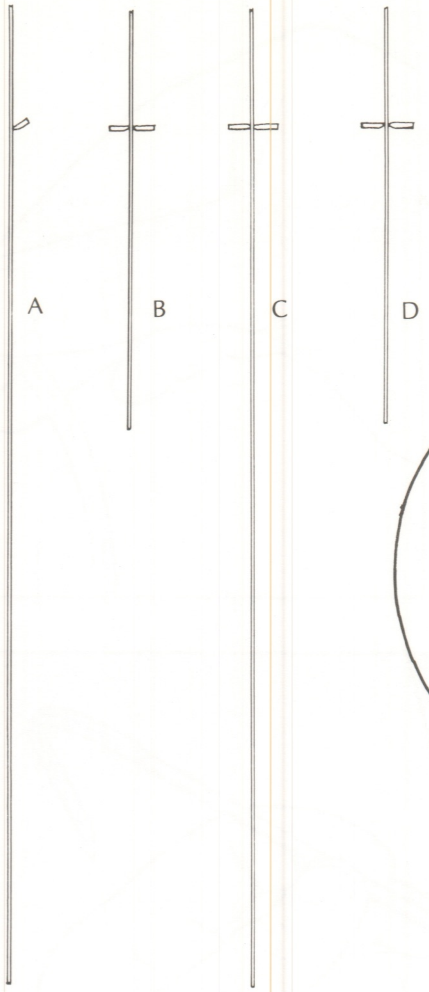
The suspension lines are continuous from the link at the harness to the top skin of your canopy where the end of the line is anchored in the top loaded seam. Where the line passes through the bottom skin at the bottom loaded seam, there is a reinforced section supporting a cross tape through the line. This tape is sewn into the bottom seam and carries the load of that seam to the line. Above this point, the line is sewn directly to the rib and ends inside the top loaded seam. The 'A' line is slightly different from the others. It is rolled into the leading edge of the loaded rib, ending in a heavy joint at the top loaded seam. It also has a cross tape installed in a different manner. You will assemble all of your line sets at the same time and later sew them onto the loaded ribs. The same stitching which secures the lines to the ribs will secure these finger trapped assemblies.

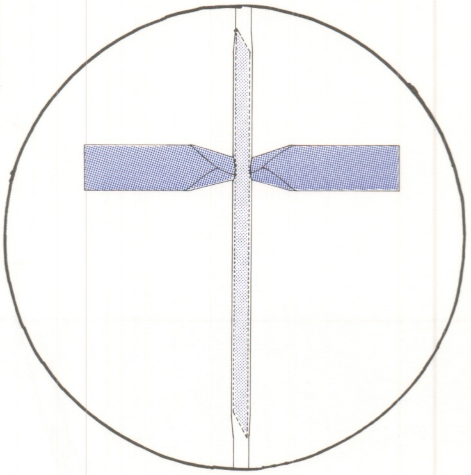
You'll use the finger trap method to splice parts together to form each assembly. The suspension line is a hollow, braided line and a piece inserted into the line will be griped very tightly when the line is under load. Sewing through the finger trapped area will bring the splice up to the rated strength of the line. You'll use a tool called a finger trapping fid to insert pieces into the hollow center. The fid is pointed on one end so you can work it into the middle of the line, and the other end is hollow and threaded so the inserted piece can be screwed into the end of the fid.

To get the greatest strength from a finger trapped splice, the piece inside should be cut off at an angle so the line will not narrow abruptly where the finger trap ends. Some parts are too hard to screw into the fid and you have to melt the end to a pointed bead to get it on the fid at all. In this case, you will always pull the melted end out at some point and cut it off, allowing the fresh cut to slip back inside the line.

Parts Required:

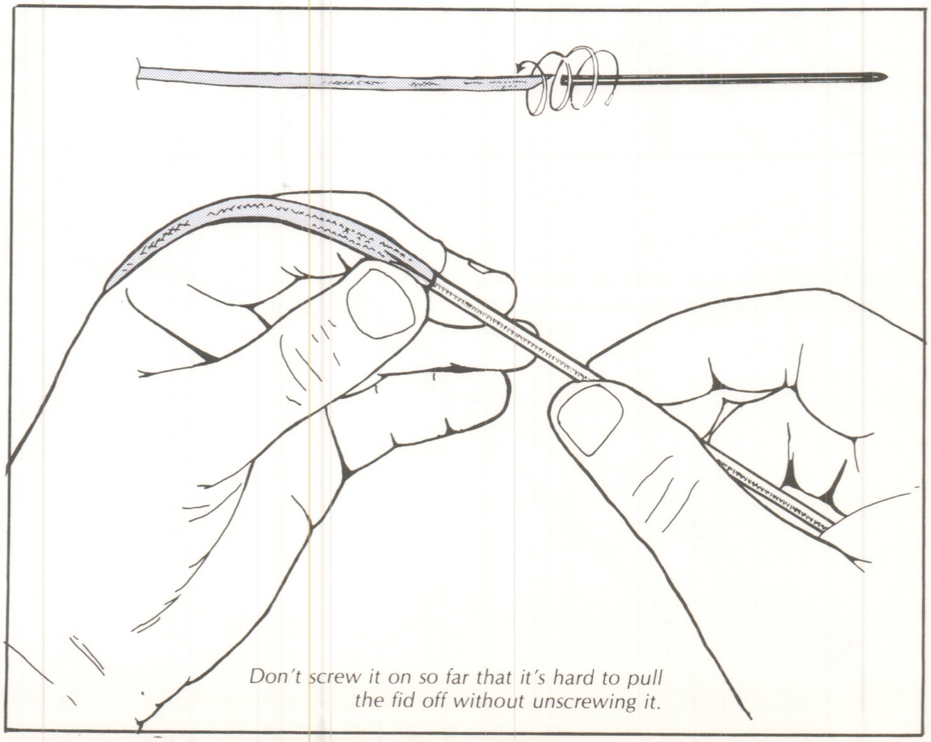
- all B, C, and D suspension lines 30 [24]
- cross doublers 30 [24]
- cross tapes 30 [24]





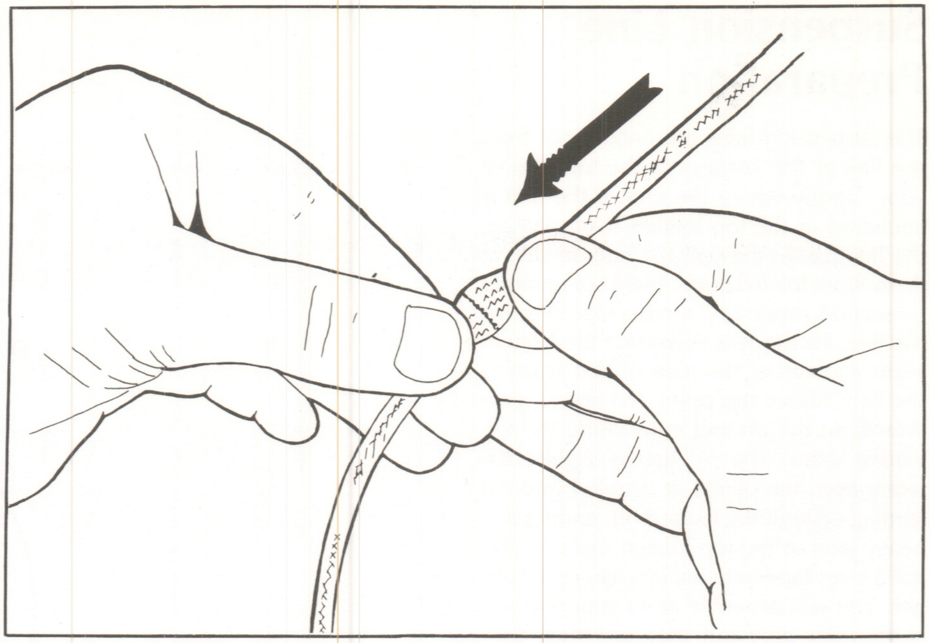
The B, C, and D lines are finished out with a cross tape through a reinforced section of the line. This tape is sewn into the bottom loaded seam when the cells are closed.

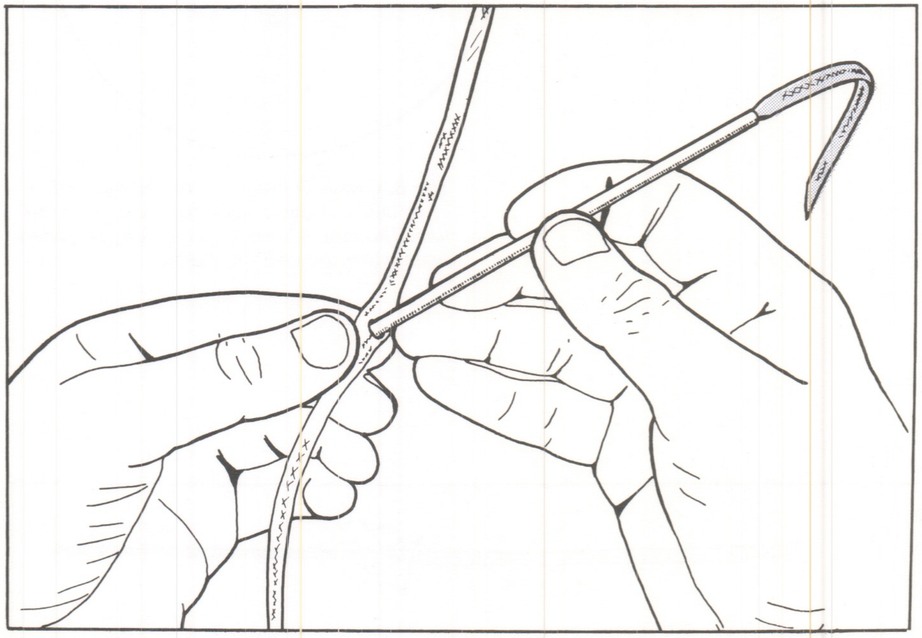
***STEP 1** Cut both ends of the cross doubler at a shallow angle and screw one end of the piece into the threaded end of the fid. We hot cut the lines so they won't come unraveled during shipping and these blunt, hard ends must be sliced off at an angle if the ends are to be inside a finger trap. If you have trouble with the freshly cut end coming unraveled, sear the cut very slightly with a small flame. Don't do this without first checking the instructions on page 30. A light singeing of the angled cut will not cause a problem inside the line, but you must avoid absolutely a hard melted bead inside the finger trap.*



Don't screw it on so far that it's hard to pull the fid off without unscrewing it.

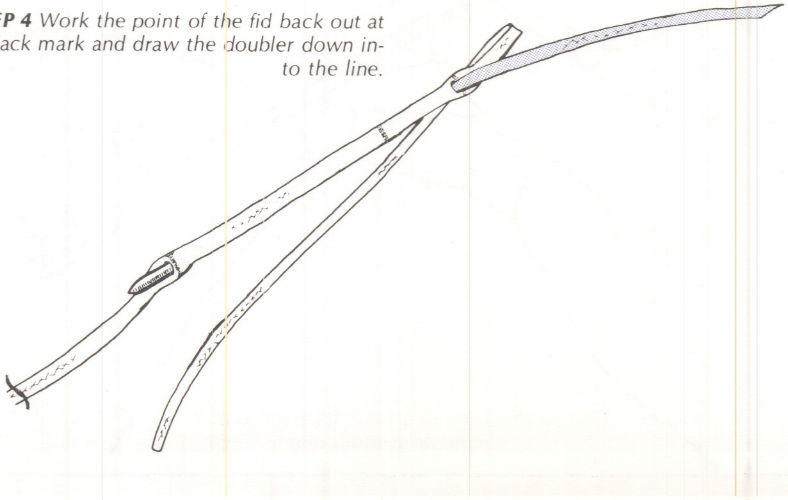
STEP 2 *To get the fid started into the line, open the weave of the suspension line by holding it on either side of the blue insert mark and squishing it together.*

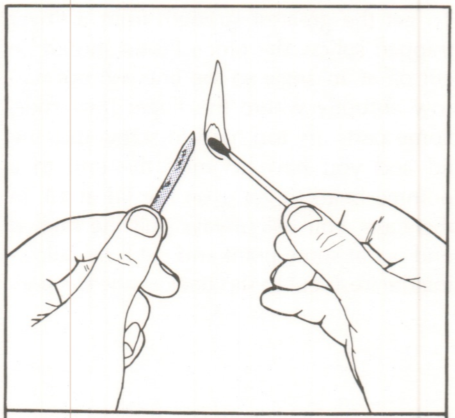




STEP 3 *Start the fid in the line at the blue insert mark and gently work it down into the body of the line in the direction of the black exit mark. (the red mark is for the cross tape)*

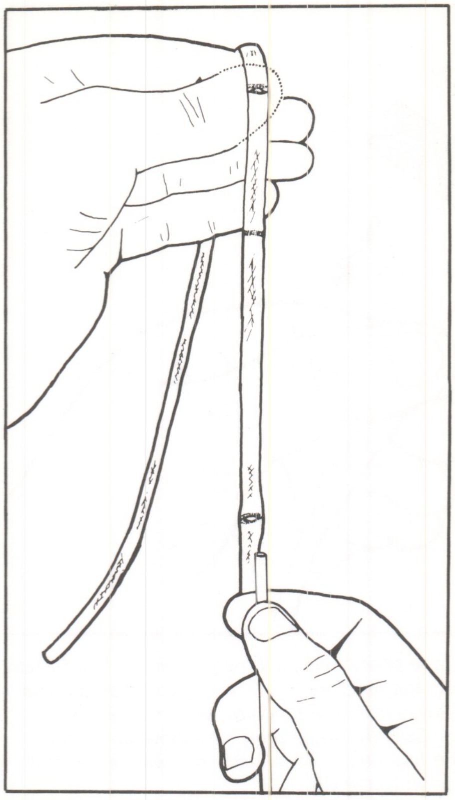
STEP 4 *Work the point of the fid back out at the black mark and draw the doubler down into the line.*



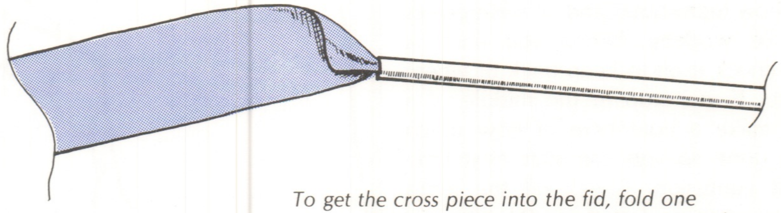


The end of the line may get fuzzy or become unravelled, especially if you're having trouble getting it into the fid. It is OK to sear just slightly the fibers to get them to hold together, however, you must not melt the end of the line into a fat bead of molten nylon. Such a hard point inside the line in the case of finger trapping will create a weak spot that may break sooner than expected.

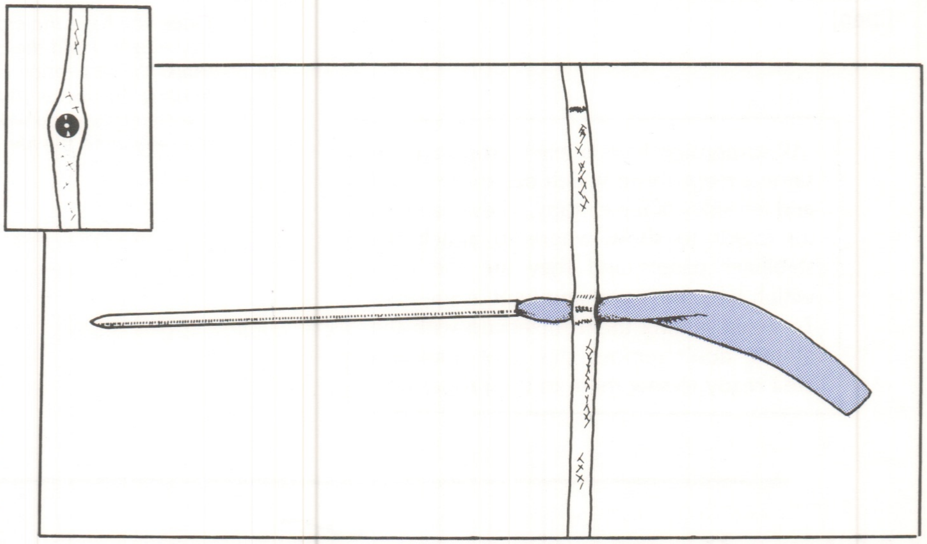
The trick is to hold the raw edge to the side of the flame where it's cooler, allowing you to sear the edge gradually.



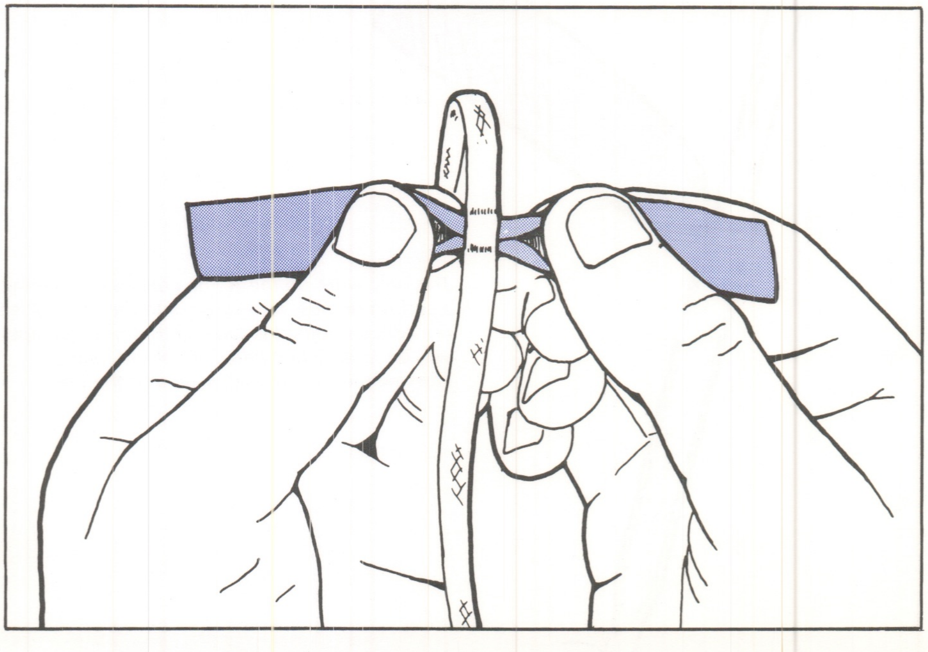
STEP 5 *Continue to withdraw the fid, pulling the cross doubler into the line. As soon as the tail end of the cross doubler disappears into the line, grasp the line tightly at this point and keep the doubler from moving. Pull the fid until it comes out of the line, leaving the doubler inside.*



To get the cross piece into the fid, fold one corner of the cross piece into a little point and screw the fid onto this point as far as you can. It should be tight so it won't pop out as you draw the piece through the line.



STEP 6 *At the red mark on the line, insert the cross tape through the line sideways, working it in one edge and out the other. Pull the cross tape until it's centered and remove the fid. To have the strongest construction possible, make sure you get an equal amount of material on either side of the fid as you work it through the line. (see edge-on view)*



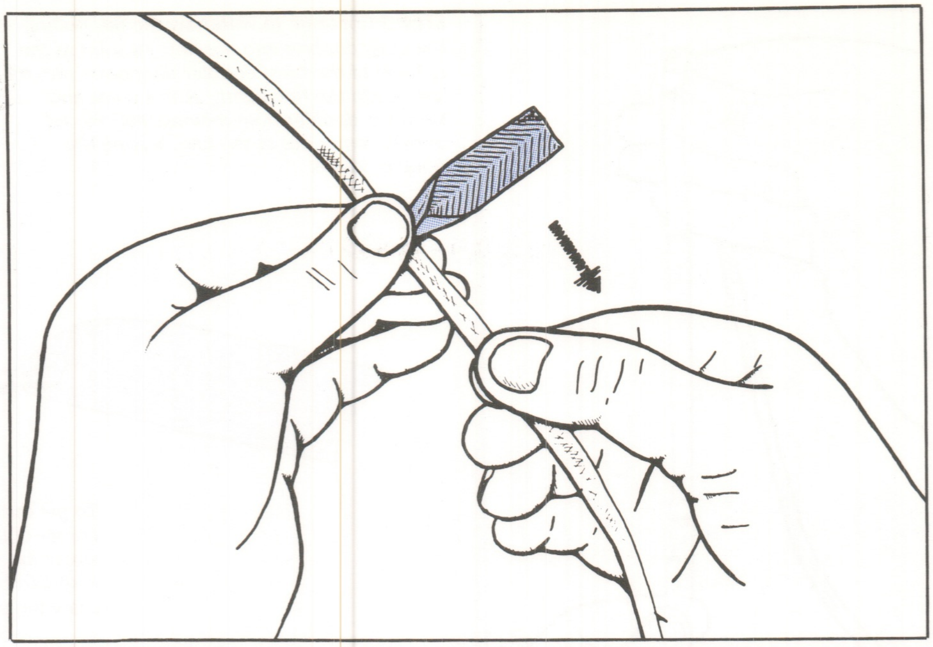
STEP 7 *Flatten out the tape and work the folds toward the center. Put tension on the tape and wiggle it around a little and it will work itself flatter inside the line.*

Completion Checkoff

Instructions under this heading will tell you whether to do the previous series of steps once or several times. A job may be done on each piece of fabric or line, amounting to the same job done several times. Other jobs are done once or, are interrupted and finished at a later stage.

After you've studied the steps, look here to see how many times and on what pieces you'll be working. When you finish a series, check it off to keep track of where you are. If you stop in the middle of a series, make a note here of how much you've done so you can start next time without confusion. Check off the items below as you complete them. [Numbers in brackets apply to 7-cell models]

- **B, C, and D Suspension line assembly complete — 30 lines [24 lines]**

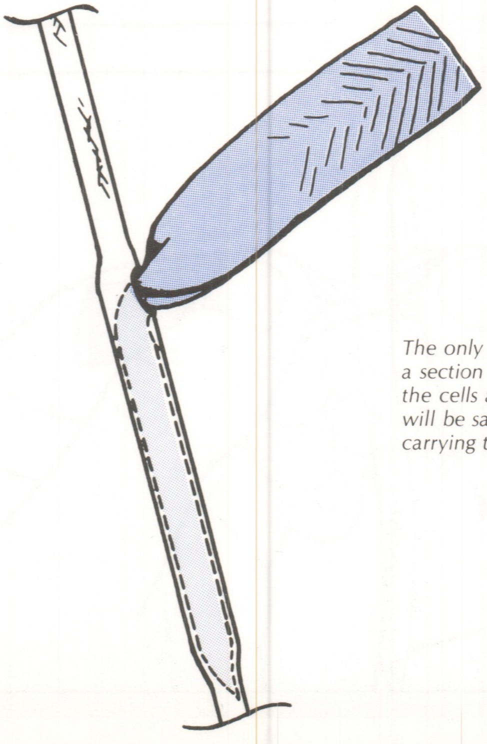


Once you have the cross tape positioned, you must work the braid back down tight. Hold the cross tape juncture tightly while you massage and 'milk' the suspension line away from the juncture, top and bottom, twisting the line as you go. Grab the suspension line above and below the entire area and jerk the braid tight. This finger trap will be sewn at the same time the line is sewn to the rib.

> All suspension lines of each group are the same except those which are on the right and left sides of the canopy. These have extra marks to show where to attach the stabilizer panels and they are the lines which have the overhand knot at the end. To avoid getting them mixed up with the others, don't remove this knot until you area ready to sew them to the proper rib.

'A' Line Preparation

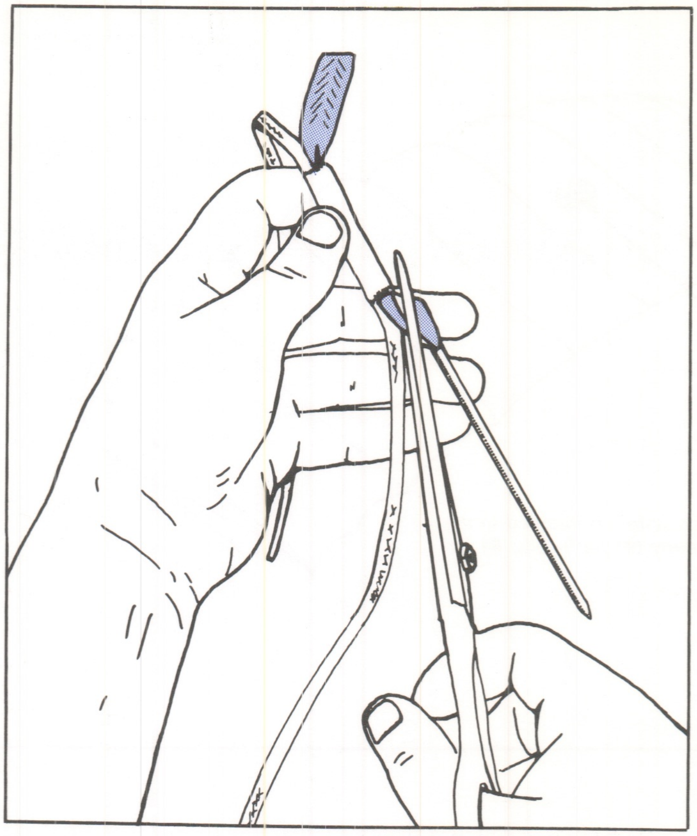
The "A" line is sewn into the leading edge of the loaded rib with the end anchored in the confluence tape at the upper front corner of the rib. The bottom seam is anchored on the line by a piece of cross tape which is finger trapped into the body of the "A" line. This will be sewn when the line is sewn into the loaded rib.



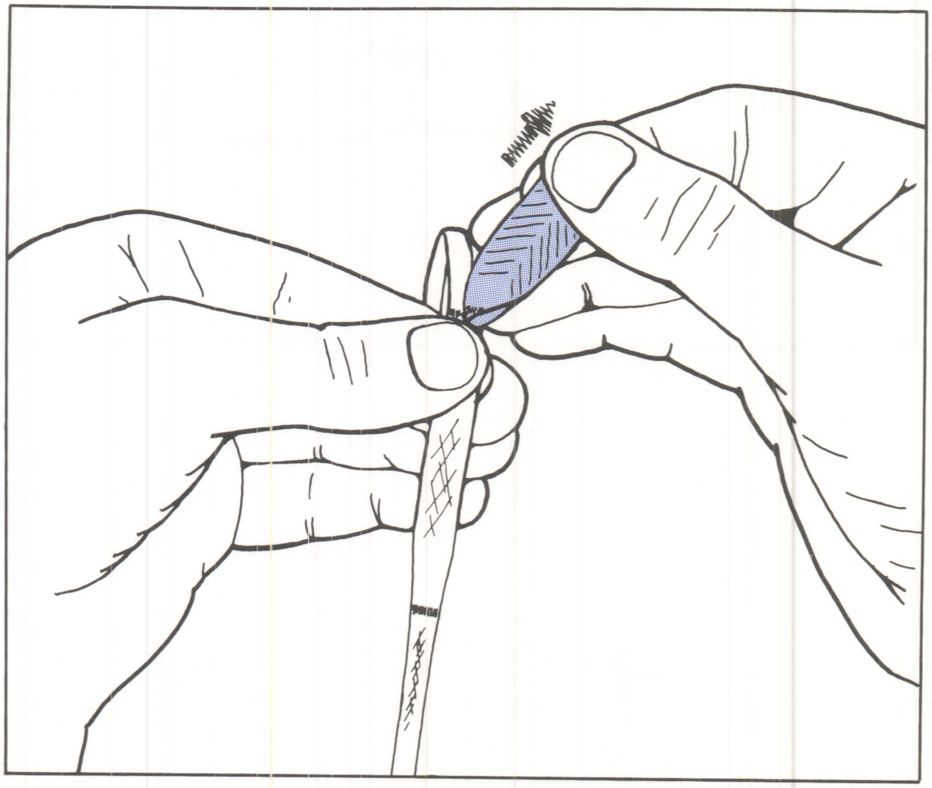
The only work on the A line consists of inserting a section of cross tape down into the line. When the cells are joined in later steps, this cross tape will be sandwiched into the bottom seam, carrying the load of that seam into the line.

Parts Required:

- all "A" lines 10 [8]
- green marked cross tapes 10 [8]



STEP 1 *Screw the fid onto the green end of the cross tape. Insert the fid, sideways, into the "A" line at the green insert mark. Run the fid down inside the line, bringing it back out at the black exit mark. Pull the cross tape into the line until a bit of it comes out with the fid. Cut the tape at an angle just above the fid.*



STEP 2 *Grasp the upper end of the cross tape and pull it back out until the green alignment mark is seen. This positions the proper length of cross tape outside the line.*

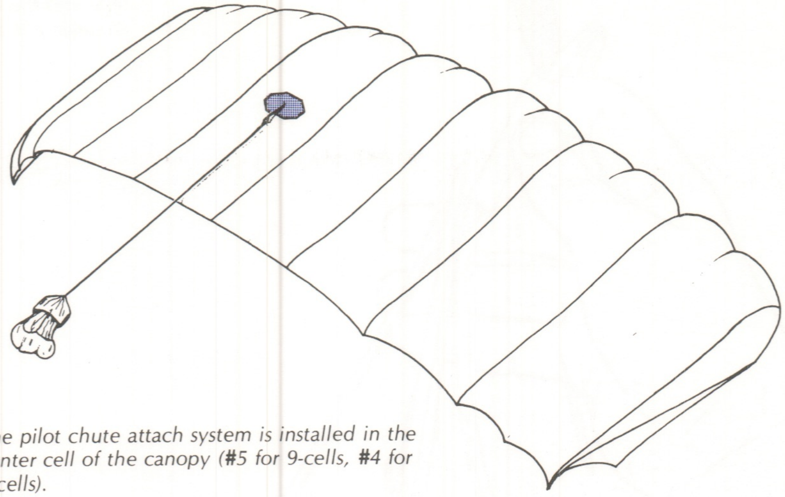
STEP 3 *Hold the line firmly where the cross tape goes in and milk the finger trapped segment down tight.*

Completion Checkoff:

- cross tapes inserted in all A lines 10 [8]

Pilot Chute Attach System

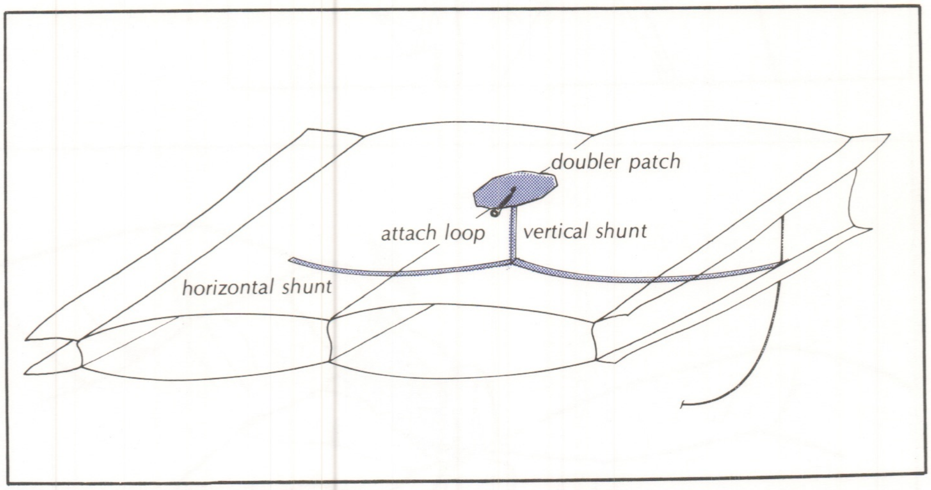
The pilot chute attach system is designed to carry pilot chute snatch loading down through the canopy and into the suspension lines without stressing the canopy fabric. The pilot chute is tied to the attach loop, the topmost component. Usually a ring is installed between the attach loop and the pilot chute bridle to keep the pilot chute from jerking part of the canopy through the deployment bag grommet as the bag is pulled out of the pack. To prevent tearing of the skin, a doubler patch is sewn on the top skin where the attach loop connects. A vertical shunt carries the loading down along the unloaded rib and into a horizontal shunt positioned spanwise on the bottom skin. This shunt ends up at the bottom attach points of a pair of C lines and is caught by the stitching in that area.

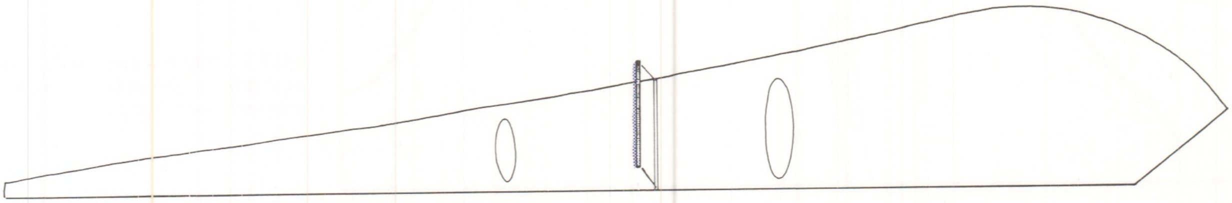


The pilot chute attach system is installed in the center cell of the canopy (#5 for 9-cells, #4 for 7-cells).

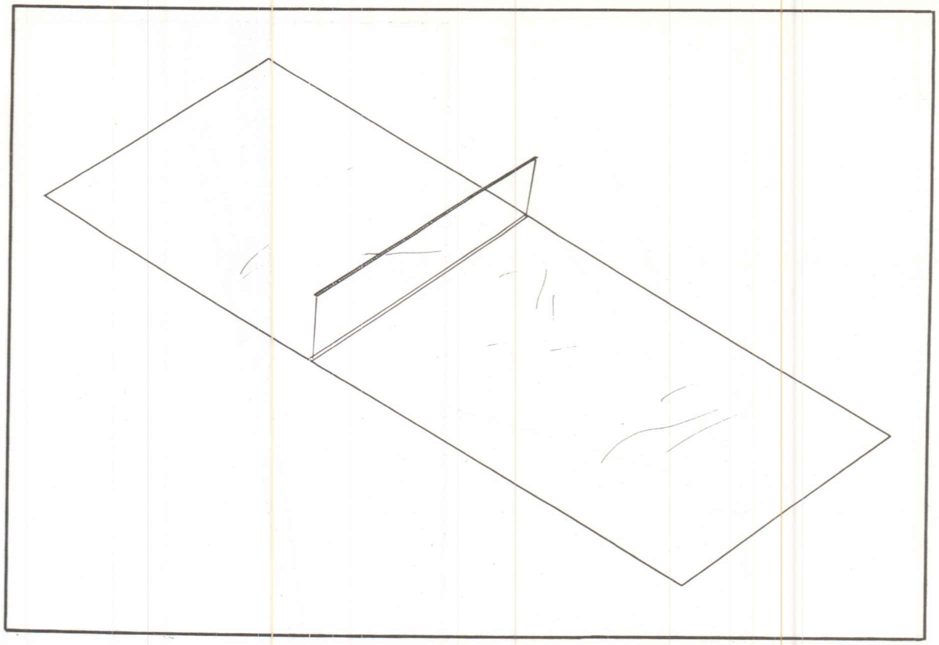
Parts Required:

- top skin #5 (4)
- unloaded rib #10 (8)
- bottom skin 2-5 (4)
- reinforcing tape
- doubler patch
- basting tape

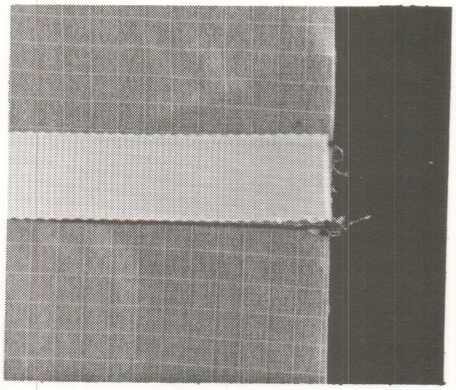


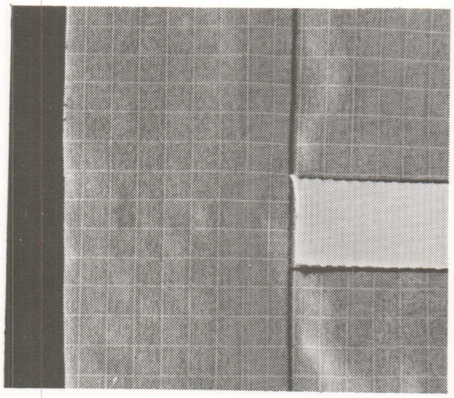


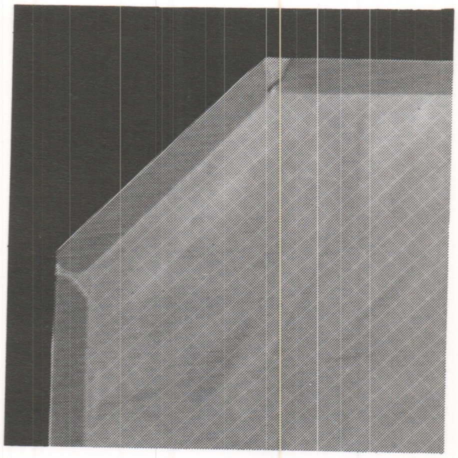
__STEP 1__ On the right side of rib #10 (8), apply a strip of reinforcing tape between the parallel lines about in the center of the rib. Trim the ends of the tape even with the top and bottom edges of the rib.



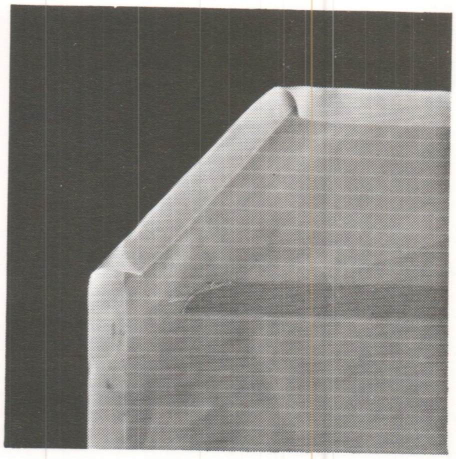
STEP 2 *Apply a strip of reinforcing tape between the spanwise parallel lines across the INSIDE surface of bottom skin #5 (#4). Peel off the paper backing as you go, making sure you keep the tape centered between the lines and without wrinkles in the cloth underneath. This shunt will not be sewn to the skin except where it meets the vertical shunt; the adhesive just lets you get it in the right place and holds it there until you get everything sewn down. The shunt does not have to be permanently attached to the bottom skin to properly do its job. The photos below show exactly how to position the ends of the tape. Remember, you're working on the INSIDE SURFACE!*



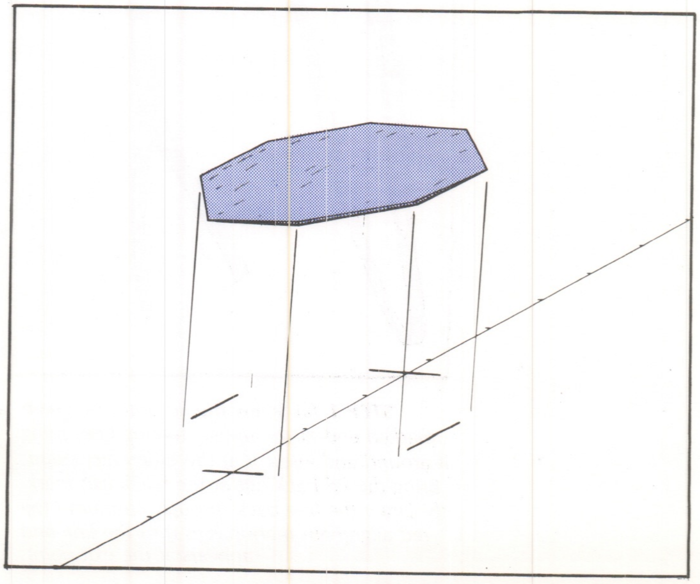




STEP 3 *With your scissors, trim the doubler patch to the marked shape. Apply short strips of basting tape to the edges of the cut as shown. You can work on either side of the piece, there is no 'top side'.*



STEP 4 *Pull off the paper backing piece by piece and turn over all the edges. Now you have a patch with raw edges turned under, ready to install. To hold it in place while you're sewing it down, stick a few strips of basting tape to this underside surface.*



STEP 5 *Remove the paper backing from the basting tape and stick the patch down on the OUTSIDE SURFACE of top skin #5 [#4] between the positioning marks. The marks are printed on the inside surface and if you can't see them very well, place a white piece of paper under the skin. It's OK to make the marks a little heavier with a pen if necessary.*

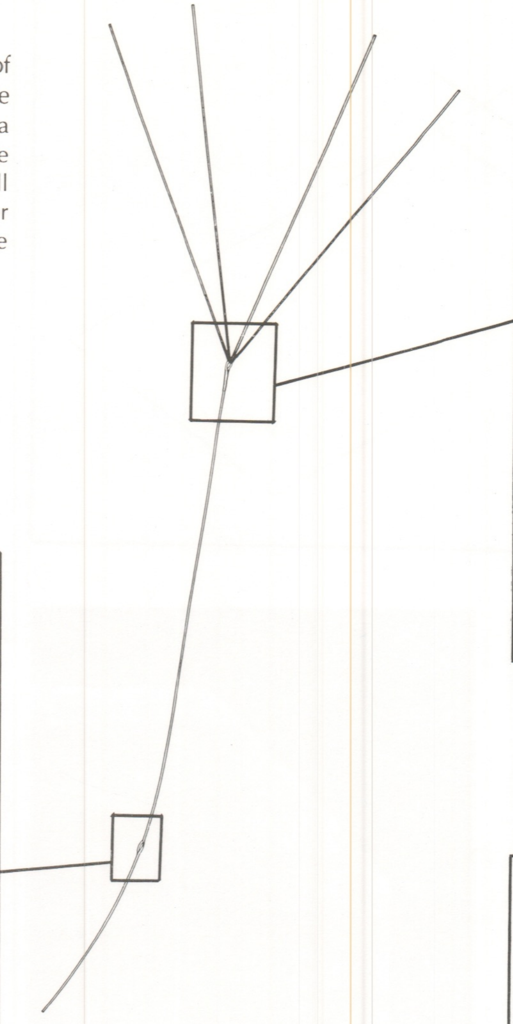
STEP 6 *Sew the patch in place with two rows of stitching around the edge as you see in the stitch chart. Use a bit of the scrap patch and fabric material to adjust the tension on your machine, you'll probably need a little more top tension than with just two thin plies of canopy fabric. Start with the outside row of stitching and remember to overstitch about an inch when you get back around to the start.*

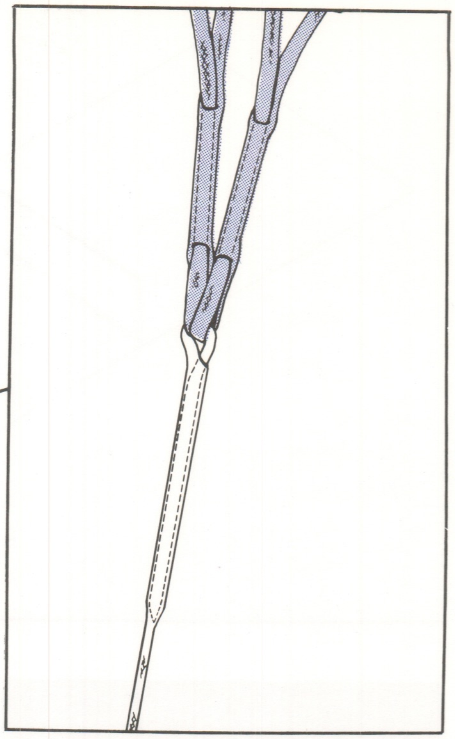
Steering Line Preparation

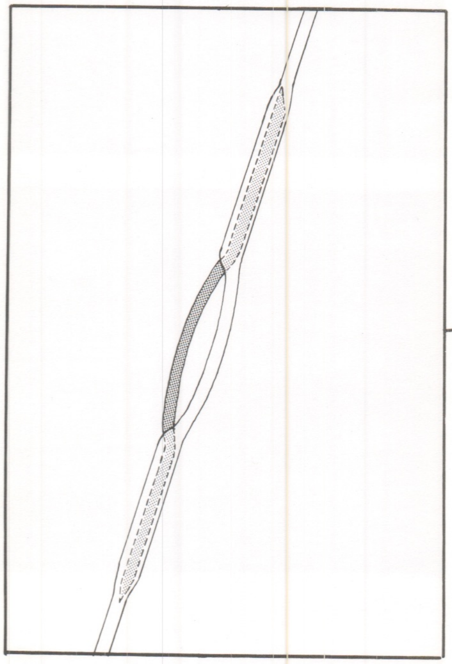
Each of the two steering line sets consists of an upper set which fans out to attach to the tail of the canopy at several places and a heavy lower line which goes from the harness up to the bottom of this fan. You'll construct the upper set, attach the lower line to it and fabricate a brake loop in the heavy lower line.

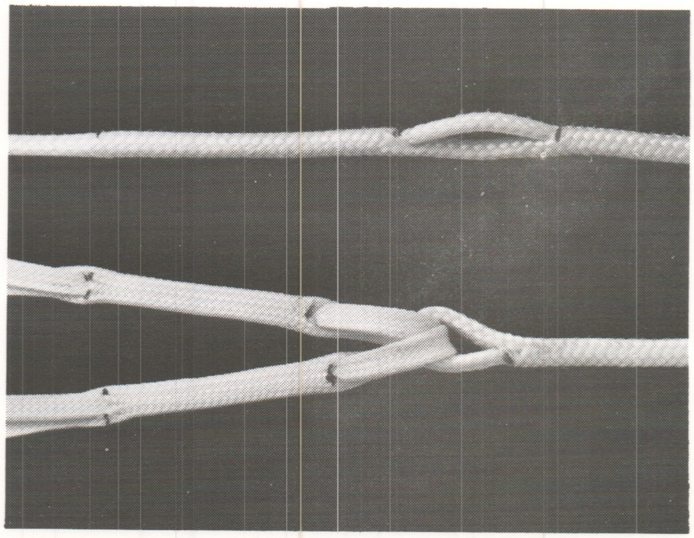
Parts Required

- upper steering set - 4
- lower steering set - 2
- brake loop insert - 2
- fid

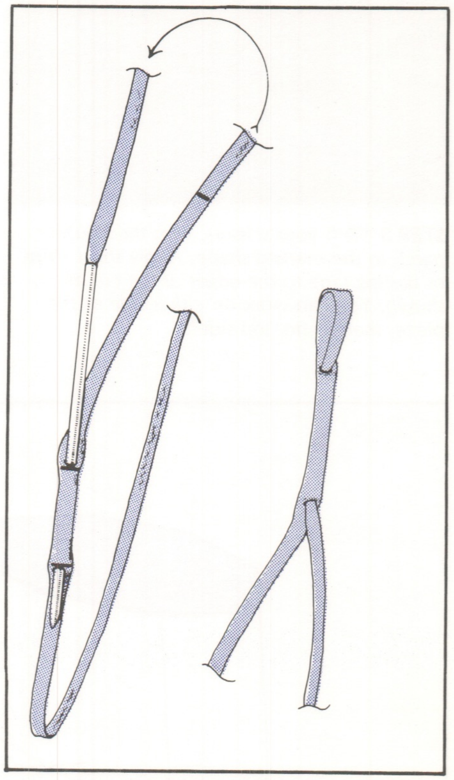




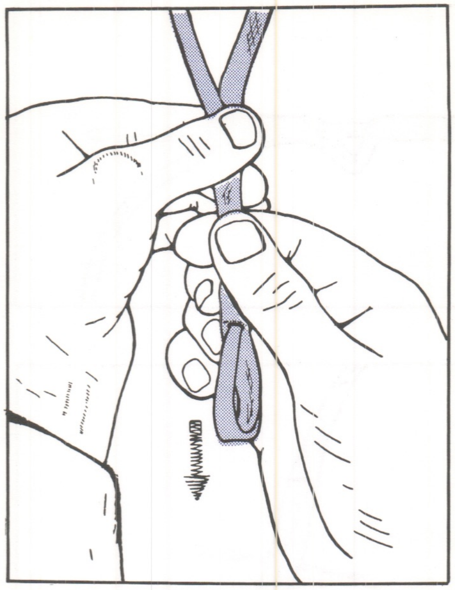




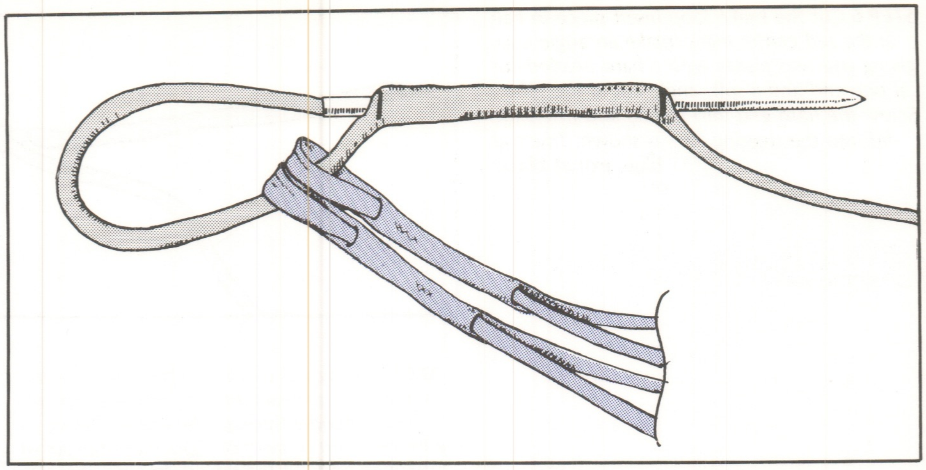
Steering line cascade and brake loop assembly before sewing.



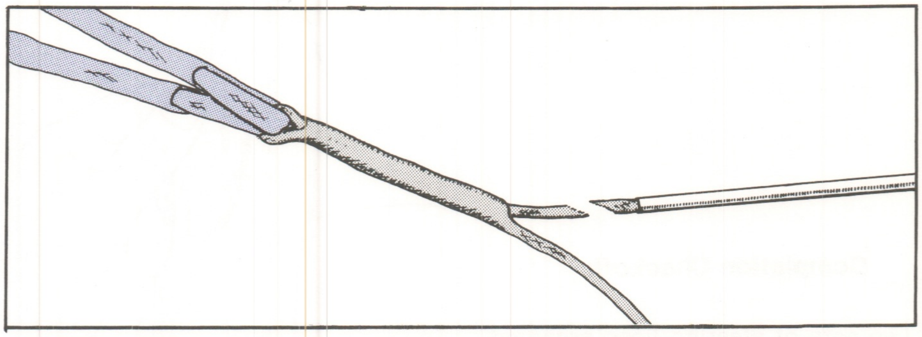
STEP 1 *(a) Screw the fid onto the green marked end of the upper steering line, bring it around and insert it at the blue entry point. Bring the fid back out at the black exit mark. (b) Draw the line back through itself until the red alignment mark passes thru the line and appears at the exit point.*



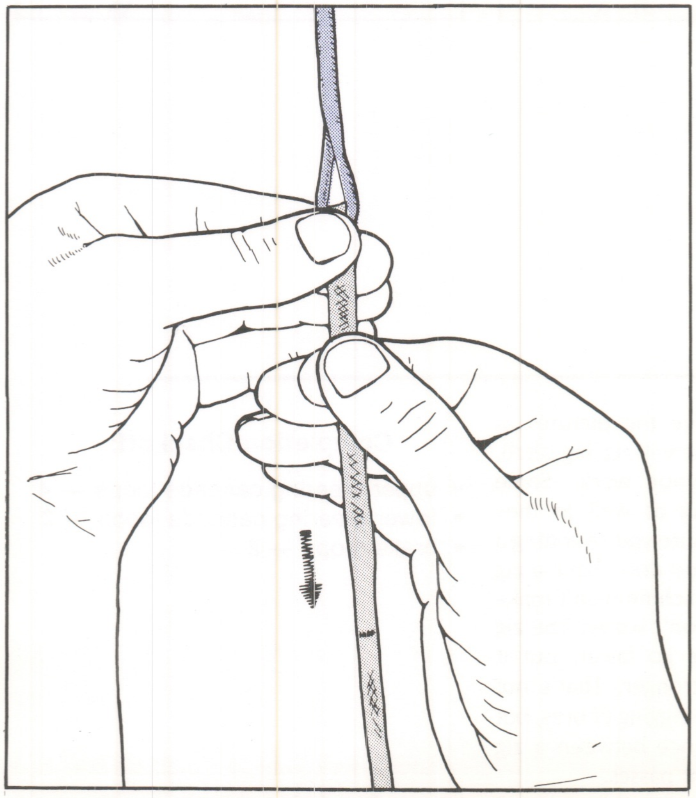
STEP 2 *Milk the finger trapped area down tight. Make sure you hold the line in position as you do this, keep the red alignment mark at the black marked exit point.*



STEP 3 *Screw the fid onto the green marked end of the lower steering line. Since the line is so big, we've cut it at an angle and heated the end to form a bead so it can be screwed into the fid. Screw it in as far as it will go. Thread two of the steering lines onto the end and insert the fid in the line at the blue insertion mark and bring it back out at the black mark.*

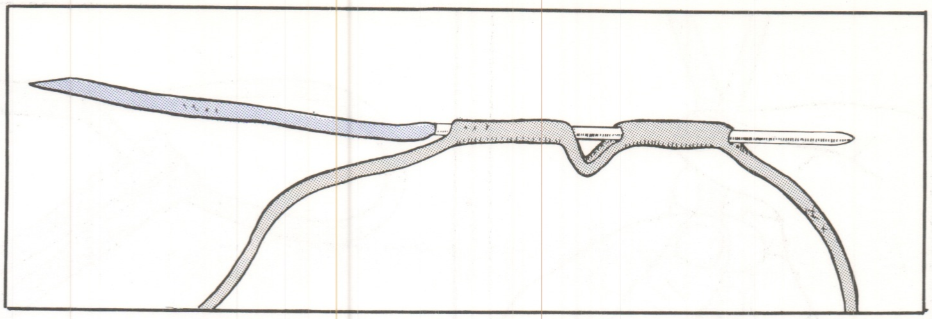


STEP 4 *Draw the fid out of the line, and pull the loop down tight on the upper steering line loops. Cut the fid off the end of the line leaving a ½ inch piece in the fid and the end of the line with soft angle cut.*

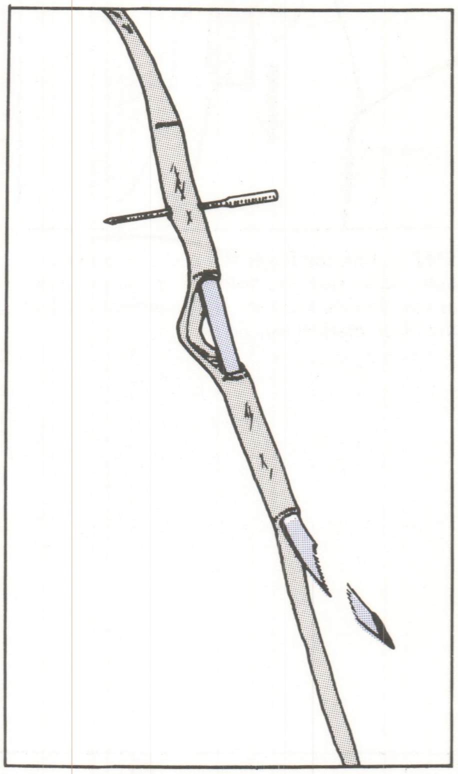


STEP 5 *Hold the loop firmly and milk the finger trapped part back down tight. The cut off end will go back inside the line.*

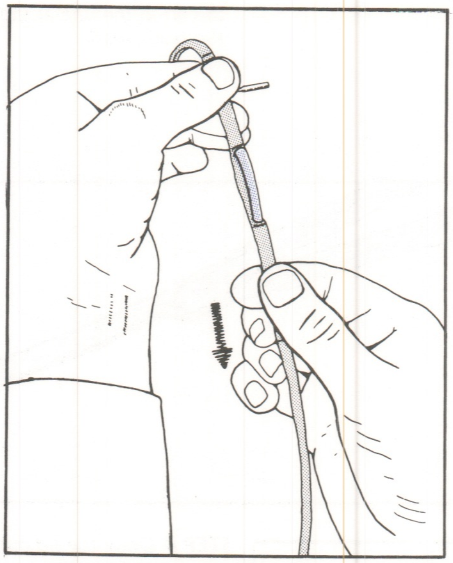
STEP 6 *Cut the brake loop insert piece in half at the red center mark (make an angle cut), giving you two pieces with a hard beaded cut at one end and a soft, angle cut at the other. Screw the hard end into the fid and insert the fid into the steering line as shown. Insert at blue, exit at black.*



STEP 7 *Draw the piece into the line until the soft end disappears into the first entry point. Stick a needle through the line as shown to hold the insert in position. Draw the fid out of the line and cut the fid off, leaving about ½ inch in the fid and a soft angle cut on the insert piece.*



STEP 8 *Leave the needle in place and milk the finger trapped areas down. The soft end will go back into the line. Remove the needle once the loop is secure.*



Completion Checkoff:

- two sets of steering lines prepared with cascades and brake loops

Sewing Finger Trapped Parts

A few stitches through the finger trapped assemblies will give them a great deal of strength. You'll need to adjust your machine to sew these thick sections. Finger trap some scrap pieces and sew on them to adjust the top tension so that the thread loops are forming inside the line. Although the parts are pretty fat, they're soft and easy to sew. Refer to the stitch chart for the sewing pattern for each piece and make your work look as much like the pictures as possible. If your machine will zig zag stitch, that will speed up your work. Some machines don't zig zag as well as they straight stitch, so make sure you're getting a good zig zag stitch. If you don't have a zig zag machine or your machine won't make a good zig zag stitch, don't worry. The zig zag makes some parts go faster, but it doesn't make things stronger. That's not always the case in some rigging chores, but here, there's no difference between a zig zag and multiple straight passes.

Completion Checkoff:

- upper steering cascade loops — 4
- lower steering cascade loops — 2
- brake loops — 2

Top Skins Prepared

The leading edges of all parts (edges of the fabric which hit the air first) must be reinforced to withstand the heavy stress of opening shock. You'll do this by rolling a piece of nylon tape into the front edge of each piece of fabric. This is tricky to do, so you'll use the basting tape in your kit to hold everything in place. Later, after you have all the leading edges taped and rolled, you'll sew them down. It is especially important that the ends of your reinforcing tape be properly positioned.

Pay close attention to the photographs of the corners on these pieces and the printed lines on the fabric.

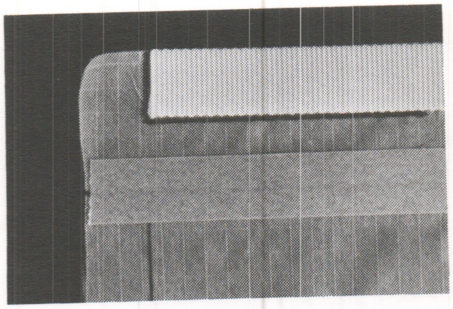
On these top pieces, if you put the tape clear to the edge of the piece, you'll have an unnecessarily bulky joint to sew when you're putting the cells together. However, if you don't carry the tape all the way to the marked positions, the tape may not get caught in the sewing at all and you risk catastrophic failure. After taping and rolling the hem, you'll next place a strip of basting tape along the right edge of all top skins except # 9 [7]. When you're putting cells together later on, you'll use this basting strip to hold adjacent cells in place while you sew them. Note that you are working on the outside surface of the top skins (remember the printing is on the inside).

Since the canopy fabric is so slippery, it's tricky to work on a slick table top. I find that a cotton bed sheet, spread out smooth and taped to the table helps in working the fabric.

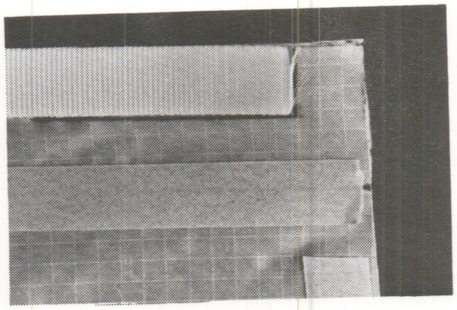
Parts Required

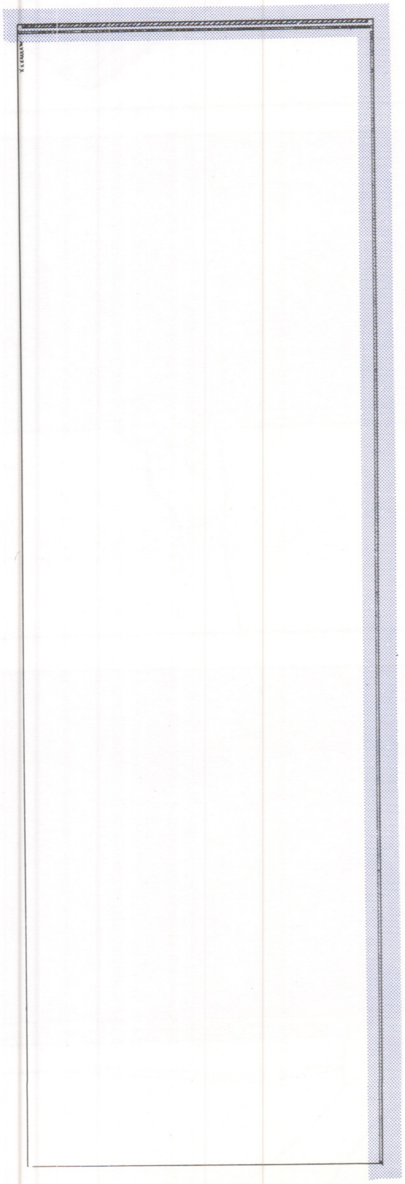
- all top skins 9 [7]
- reinforcing tape
- basting tape

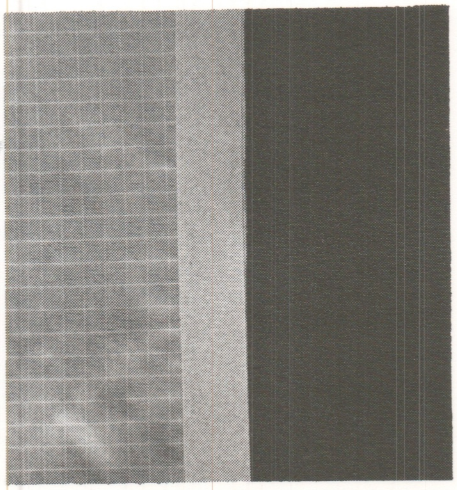
Front left corner of top skin. The basting tape goes to the edge of the fabric, the reinforcing tape stops short at the marked point.



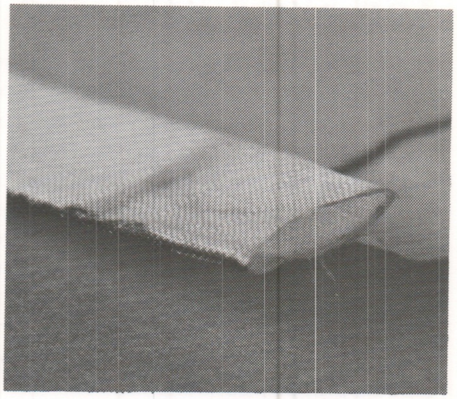
Front right corner of top skin. The tape ends are positioned like those on the left corner. Note basting tape position right edge of the piece.



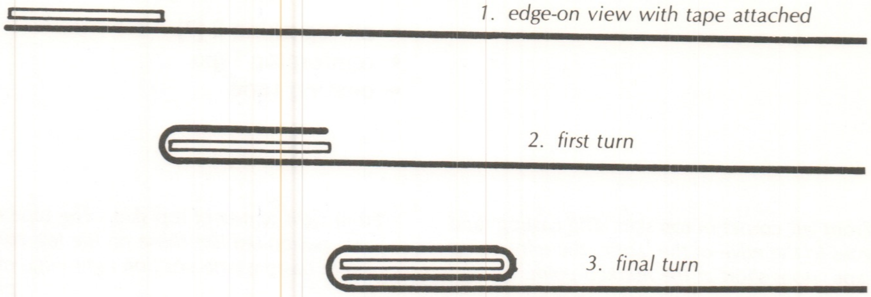


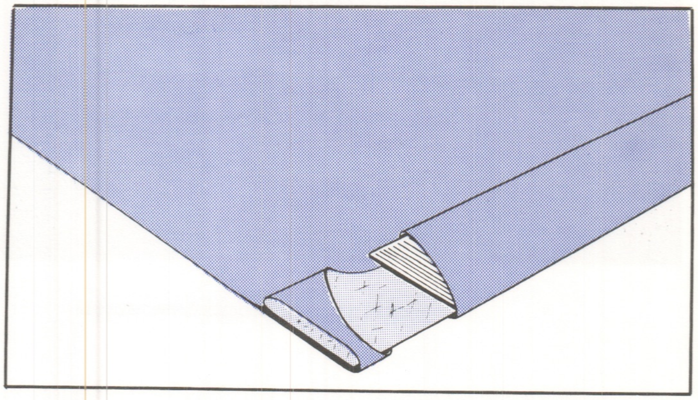


Basting tape is positioned along the right edge, outside surface of the top skin.

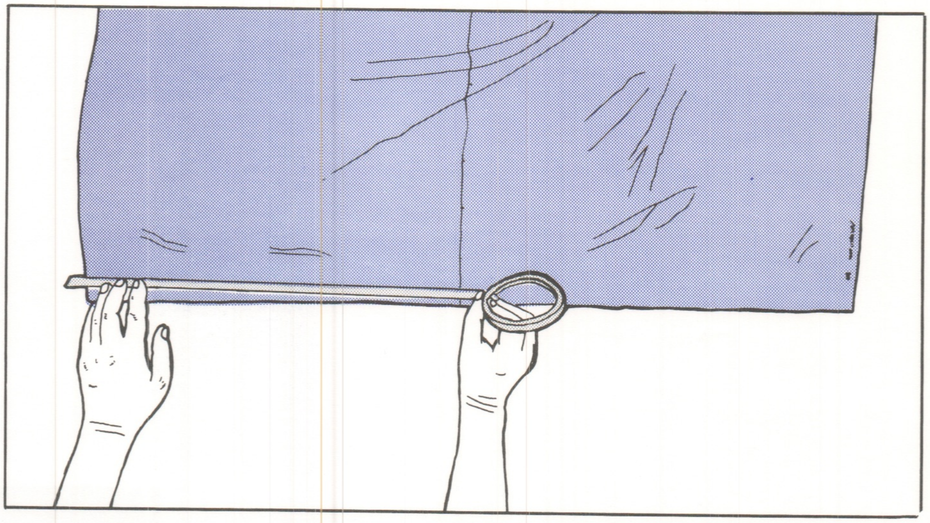


Front left corner of top skin leading edge after the hem has been rolled. Spanwise line on front shows hem has been rolled properly.

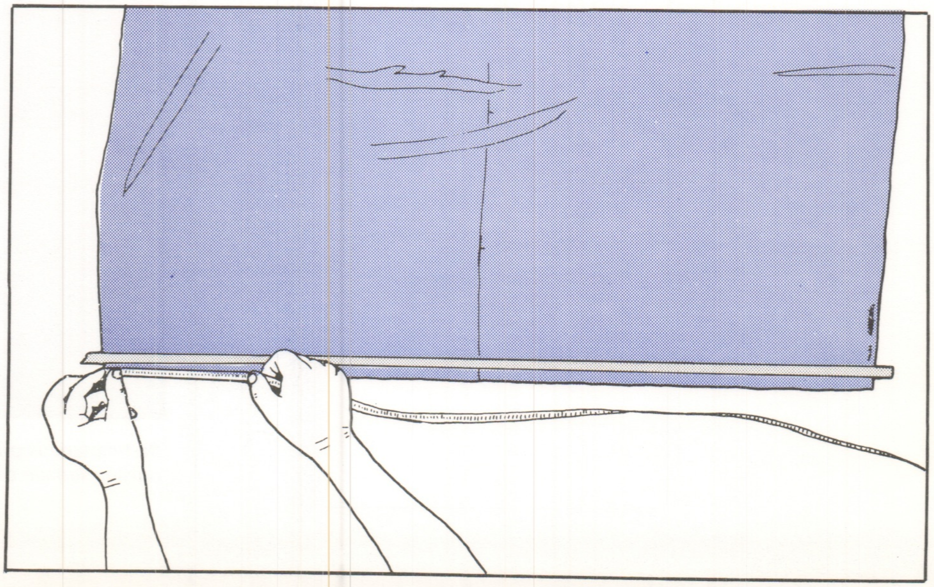




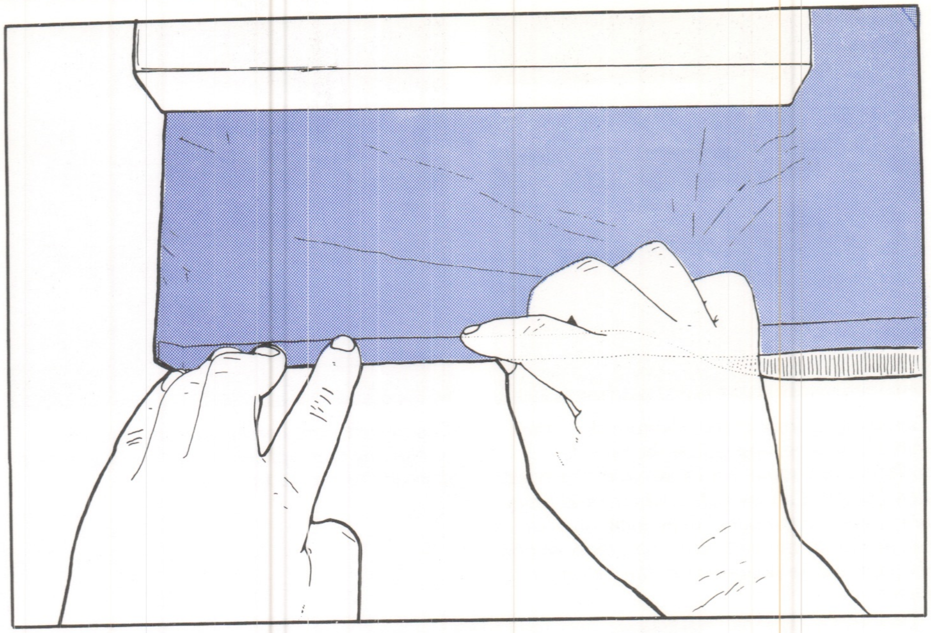
This cutaway view of a leading edge hem shows the reinforcing tape rolled inside the hem. In this instance, although the tape does not come all the way to the edge of the fabric, it does end at a specific, marked point. On the bottom skins, unloaded ribs, and stabilizer panels, the hems will be rolled in the same general manner, but the location of the tape ends will be different on each part. When the hem is rolled tightly, the spanwise line which guides the application of the basting tape will end up on the very front edge of the hem all the way across.



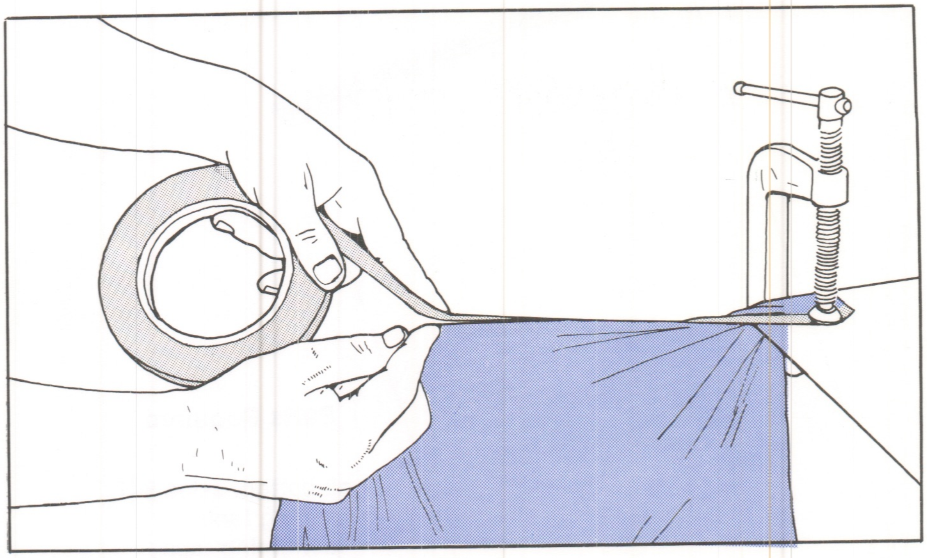
STEP 1 Lay out the top skin surface down, with the front edge facing you. You're working on the outside surface, with the skin's left side on your right. You know you have it properly positioned when the label is on your right and the printed side is down. Apply a strip of basting tape centered on the line about ¾ inch in from the edge. Stick a short bit of the basting tape down to the work surface to help hold things steady and apply the tape, allowing an inch to stick out past the other end of the cloth to hold down that side. Mash the tape firmly to the fabric.



STEP 2 Apply the reinforcing tape to the very edge of the piece. Stick down a few inches at a time, peeling off the paper backing as you go. Printed lines on the cloth will show you exactly where to place the tape; make sure your corners look like the photos.



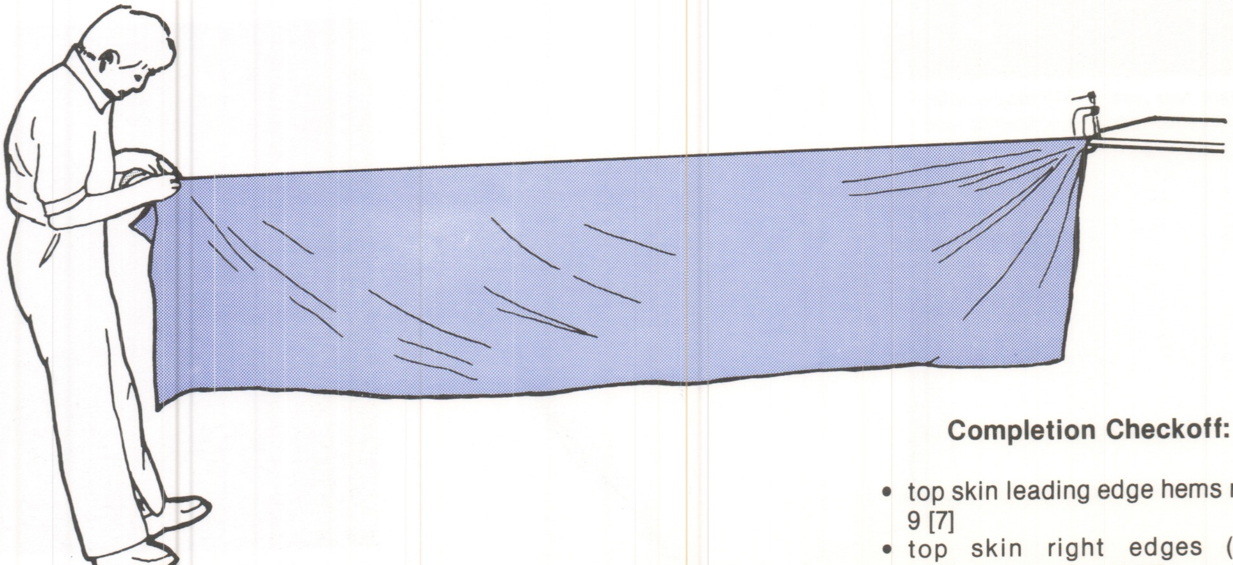
STEP 3 *Peel the paper carrier from the basting tape put down in step 1. If the adhesive comes up with the paper, put it back down and mash the tape hard to get the adhesive to stick on the cloth. Roll the reinforcing tape over and stick it down to the exposed adhesive. To get a tight roll, place a heavy book on the fabric to hold it in place and to give you something to pull against. When you get it right, the edge of the tape will fall on the line used earlier to position the basting tape. Move the book along as you go. Once you get the first roll down, do it again to complete the hem. Squeeze the finished hem to set the adhesive firmly.*



STEP 4 *Apply the basting tape to the right side of the top skin, along the edge (tape goes on outside surface).*

One quick way to do this is to get the tape started and then clamp the corner down and move backwards, applying the tape as you go. Any method of holding the corner down is OK, the human hand works fine if you've got an extra one around. Make sure you squeeze the tape firmly so the adhesive will grip the cloth.

Note: Do not put basting tape along the long edge of top skin *#9 [7].*



Completion Checkoff:

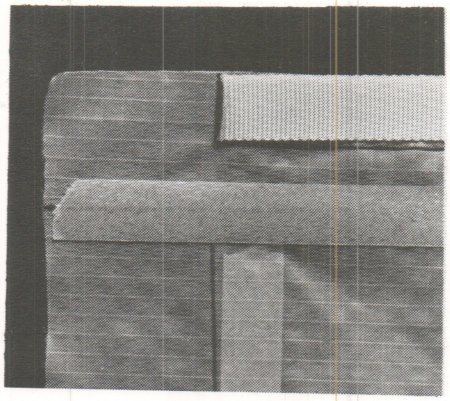
- top skin leading edge hems rolled — 9 [7]
- top skin right edges (outside surface) taped — 8 [6]

Bottom Skins Prepared

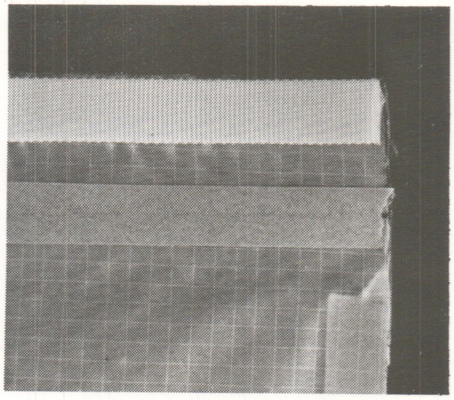
You'll apply reinforcing and basting tape on the leading edges of all bottom skins and roll the hems generally the same as you did on the top skins (outside surface).

Pay special attention to the positioning of the reinforcing tape; the ends must be in the right place on each side for the tape to be caught in the stitching when the cell is completed. On the inside surface of the bottom skins you'll place basting tape along the right side, about two inches in from the edge, and on the left side along the edge itself. When you're putting your cells together, you'll use these tapes to hold things together until you sew the seam.

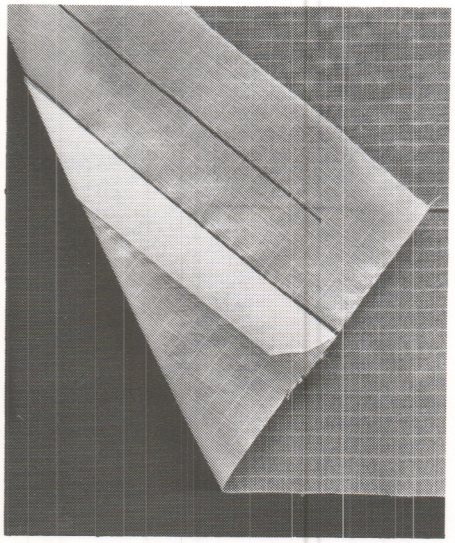
Notice that bottom skin #1 is a little different from the others. It is slightly wider because there has to be a little extra fabric on the far left side to form the bottom seam on that side. Therefore on this skin, you'll apply the basting tape on its left side exactly as you do for all the right sides, that is about 1½ inches in from the edge.



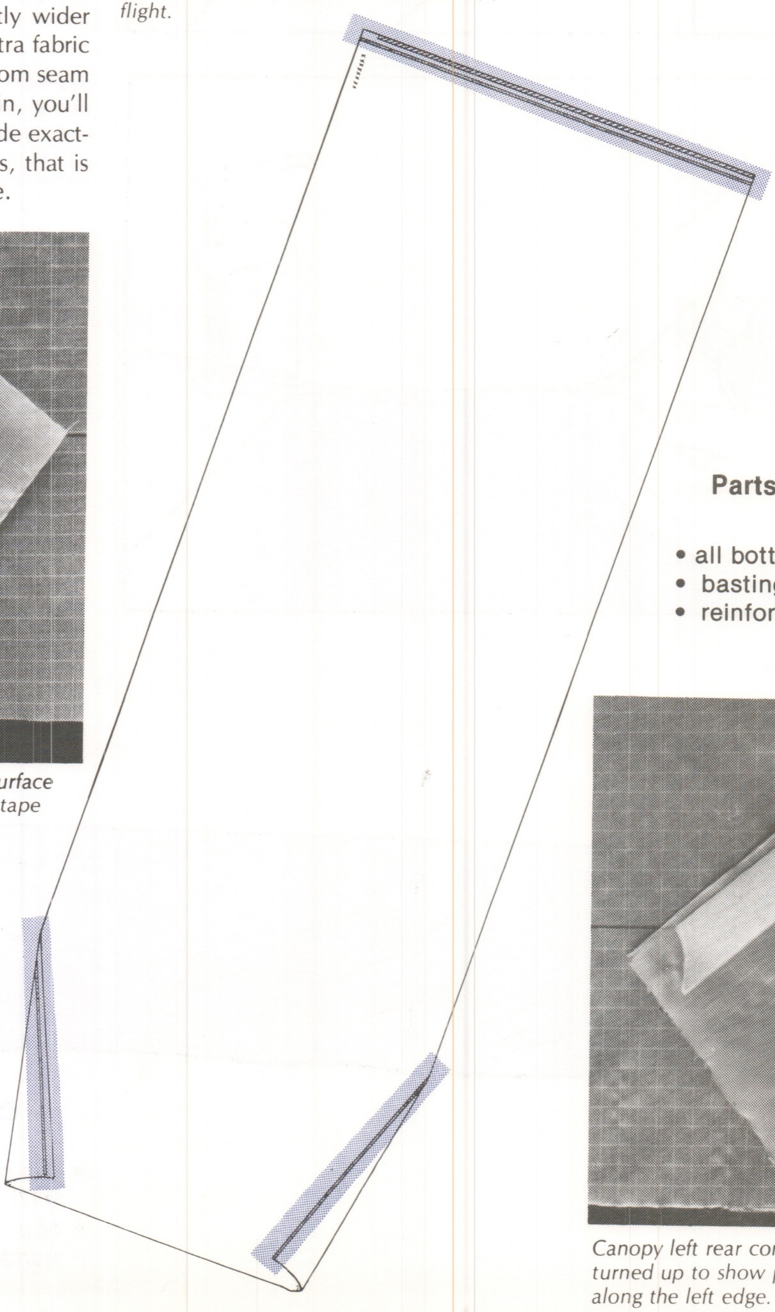
Canopy right front corner, bottom skin. The reinforcing tape, applied on the outside surface, stops about 1½ inches from the edge. REMEMBER: Canopy right and your right may not always be the same, depending on your orientation to the part. Just try to think of how the part will be positioned in the canopy in flight.



Canopy left front corner, bottom skin. The reinforcing tape applied on the outside surface goes all the way to the edge.

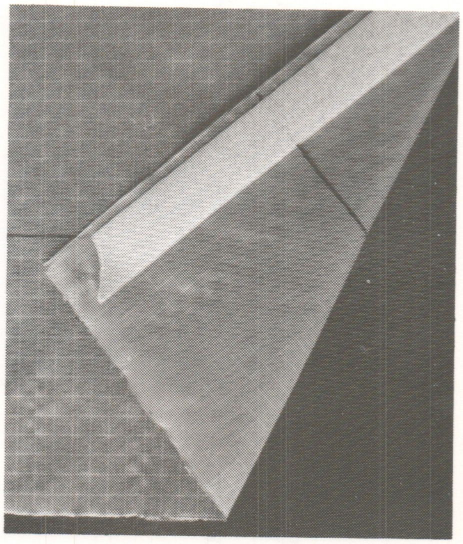


Canopy right rear corner with inside surface turned up to show position of basting tape along the right edge.



Parts Required

- all bottom skins 9 [7]
- basting tape
- reinforcing tape



Canopy left rear corner with inside surface turned up to show position of basting tape along the left edge.

STEP 1 Apply basting and reinforcing tape to the leading edge (outside surface) of the skin as you did with the top skins EXCEPT make sure your tape ends where the fabric is marked and as shown in the photograph.

STEP 2 Peel the backing off the basting tape and roll the hem as you did with the top skins. Keep the hem tight so that your basting tape guide line ends up right on the front edge all the way across.

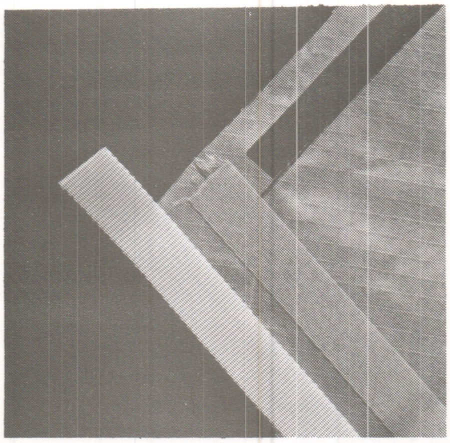
STEP 3 Turn the skin over and apply a strip of basting tape along the right and left edges from front to back. Refer to the photographs and remember that on canopy left, the tape goes along the edge and on canopy right, the tape runs on the inside of a printed line about 1½ inches in from the edge.
And . . . REMEMBER that on skin # 1 only, the left and right sides are alike, the tape is placed inside of the line on both sides.

Completion Checkoff:

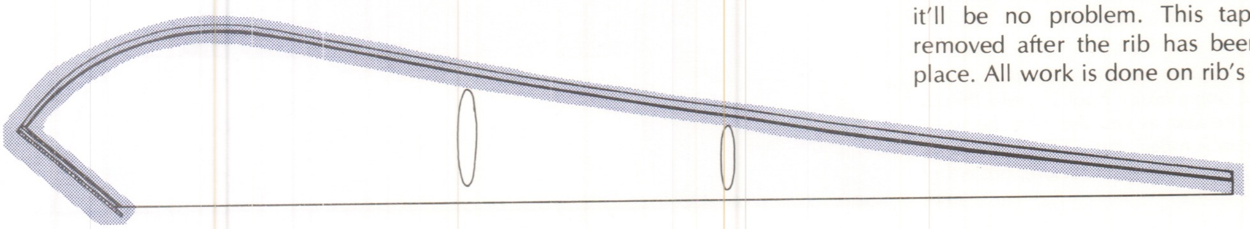
- all bottom skin leading edges hems rolled 9 [7]
- all chordwise edges taped — 9 cells [7]

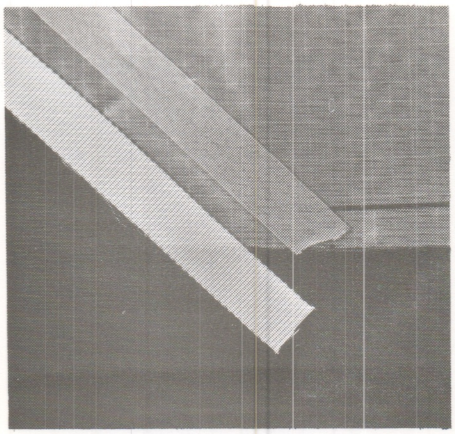
Unloaded Rib Prepared

The slanted leading edge of the unloaded rib is reinforced like the leading edge, top and bottom skins. This edge is very delicate since it is cut on the bias (across the grain of the fabric) and you must be careful when handling it. Anytime the fabric is bias cut, the edge can be pulled out of shape easily and since almost the entire upper edge of the rib is bias cut, the ribs are sensitive to rough handling. The best idea is handle them as little as possible until they're taped. To control the curved upper edge, you'll apply a strip of red stabilizing tape where indicated. Once the bias cut is stabilized, it'll be no problem. This tape will be removed after the rib has been sewn in place. All work is done on rib's left side.

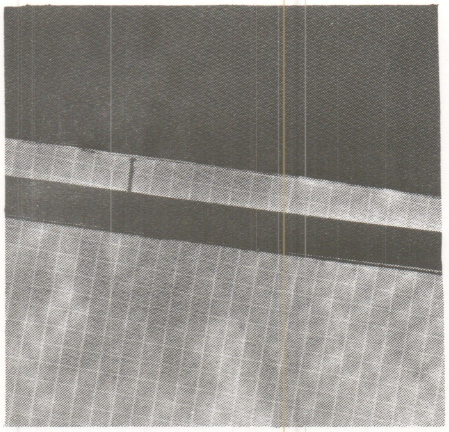


Front top corner of unloaded rib (left side) with tapes in position. The basting tape goes from top to bottom edge, centered on the guide line like the skins. The reinforcing tape overhangs the top edge about ½ inch and will be cut off after the hem is rolled.





Front bottom corner of unloaded rib (left side) with tapes in position. Basting tape goes to the edge and the reinforcing tape overhangs about an inch and will be cut off after the hem is rolled.



A continuous strip of stabilizing tape goes from the nose to the tail positioned ABOVE the guide line as shown.

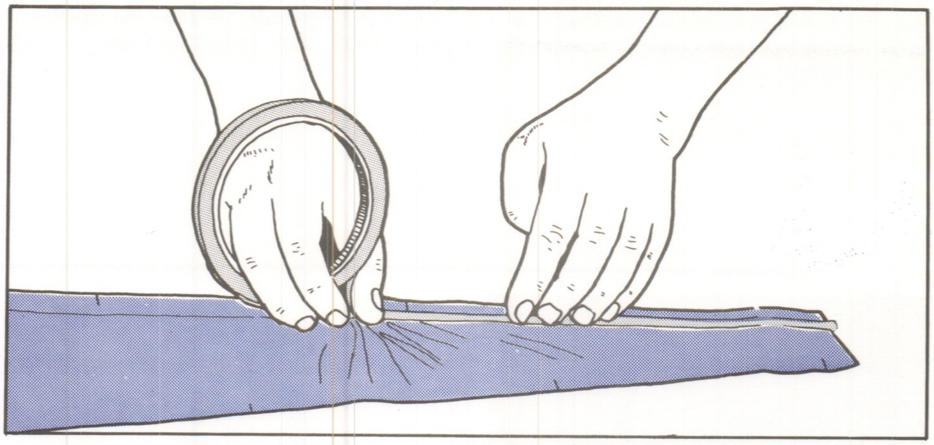
Completion Checkoff

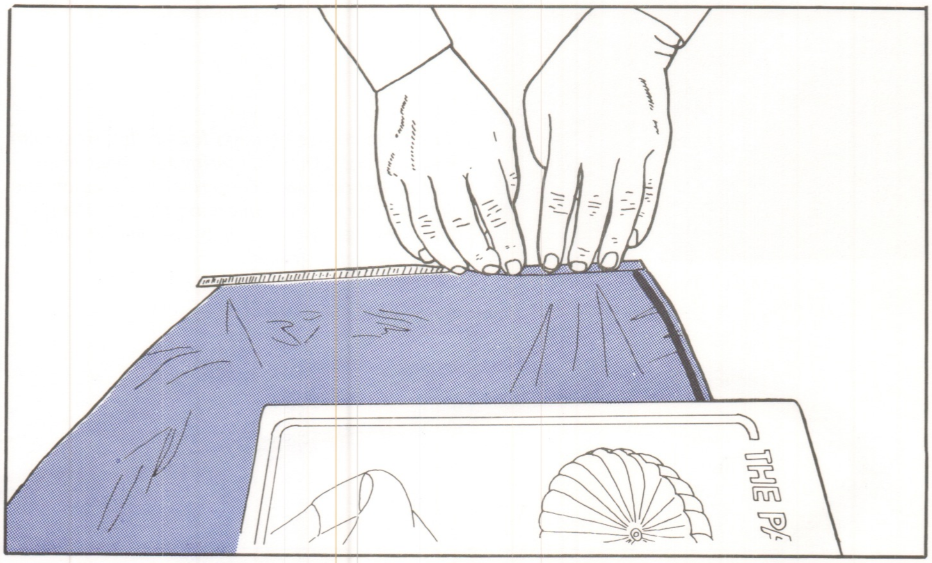
- reinforcing tape
- stabilizing tape
- all unloaded ribs 9 [7]
- basting tape

STEP 1 *Apply a strip of basting tape on the line which is about ¾ inch in from the slanted leading edge.*

STEP 2 *Apply a strip of reinforcing tape to the slanted leading edge.*

STEP 3 *Apply the stabilizing tape along the guideline at the top curved edge of the unloaded rib. Start at the tail as shown and work toward the nose, inches at a time. When you get to the curved part near the front, you won't be able to lay the tape down in a true curve but you can approximate a nice curve by laying down a series of short lengths of an inch or so. Be very careful not to stretch the raw bias cut as you do this. Stick the tape lightly down so you can pull it up to reposition it if necessary. Once you have the tape where you want it, go back and press it firmly down. Note that the tape is positioned along the top side of the guideline leaving about ¼ inch from the tape to the edge of the rib.*

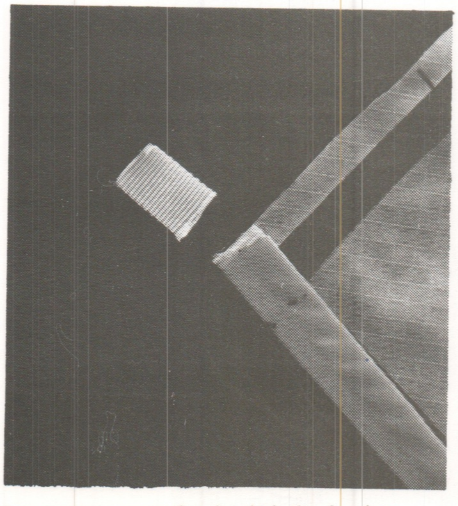




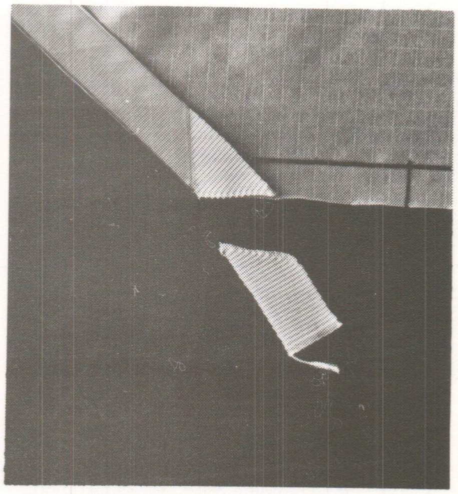
STEP 4 *Using a heavy book to hold the rib steady, roll the hem as you did with the skins. Once the hem is rolled, cut off flush the bit of reinforcing tape which is sticking out either end.*

Completion Checkoff:

- leading edge hem rolled on unloaded ribs 9 [7]
- upper curved edge stabilized 9 [7]

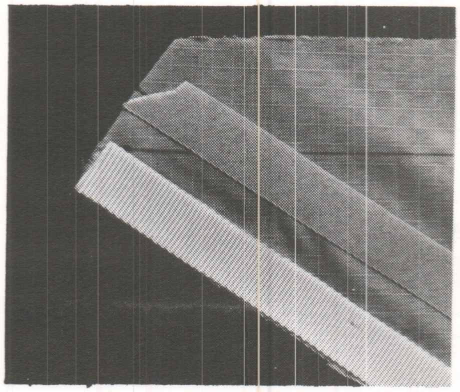


Front top corner of unloaded rib after hem rolled.



Front lower corner of unloaded rib after hem rolled.

Stabilizer Panels Prepared



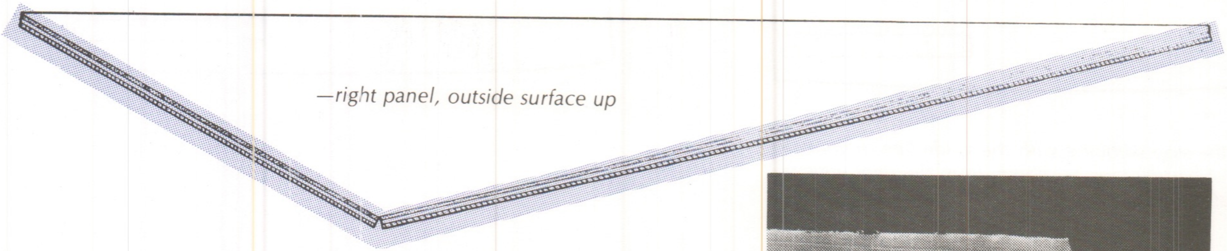
Rear corner of right stabilizer panel. The hem is taped and rolled like the skins.

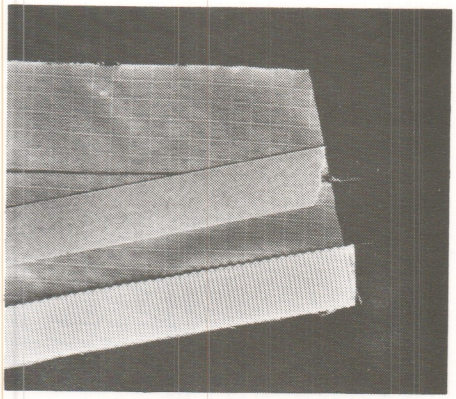
Parts Required:

- stabilizer panels•2
- basting tape
- reinforcing tape
- slider stop pieces•6
- slider stop tie ins•6

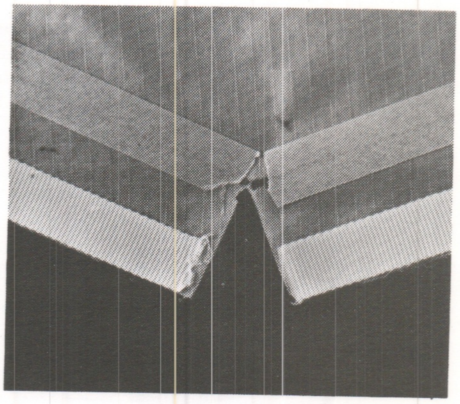
The edges of the stabilizer panels are reinforced like the leading edges of the other parts. The long upper edge which attaches to the canopy requires no special work. You'll prepare hems on the lower outside edges (leading and trailing) as you did on the skins. These edges are bias cut so be careful when handling them. After you have rolled the hems, you'll prepare 6 slider stops and later install them on the stabilizer panels after the hems are sewn.

Note that the hems are rolled to the outside of the canopy as were those on the skins. The slider stops go on the inside of the panels. It doesn't make any difference which is left or right, just make sure you lay them out like in the drawings below so you're sure to have one of each.

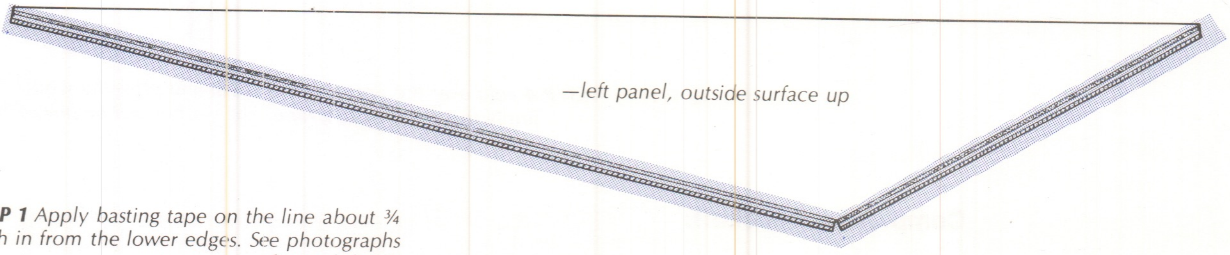




Front corner of right stabilizer panel.



Lower corner, right stabilizer panel. The fabric is notched here to permit the hem to be rolled without binding.



STEP 1 *Apply basting tape on the line about ¾ inch in from the lower edges. See photographs for end detail.*

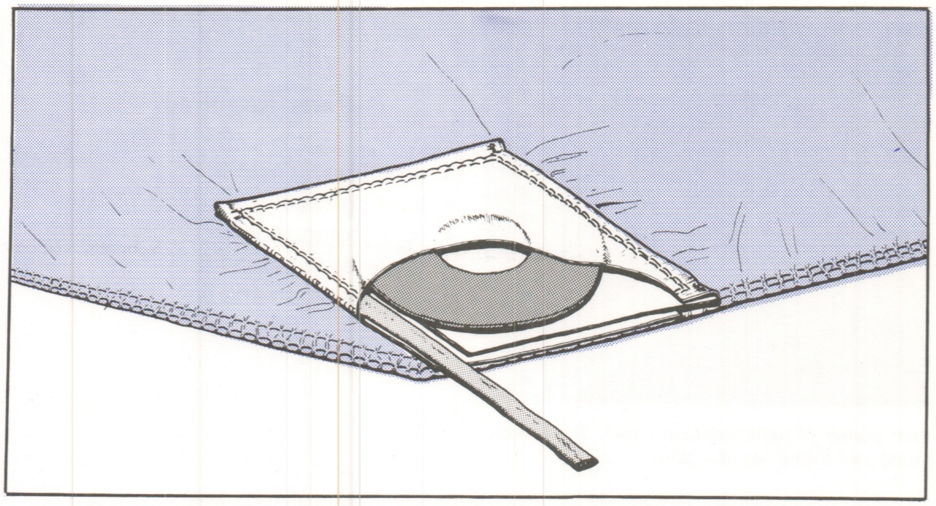
STEP 2 *Apply reinforcing tape along the two lower edges of the fabric. See photographs for end details.*

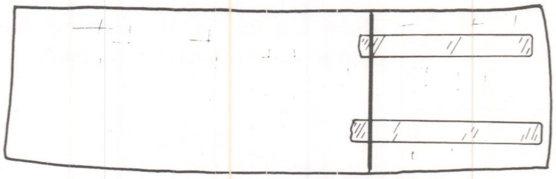
STEP 3 *Roll the hems as you did on the skins.*

Completion Checkoff:

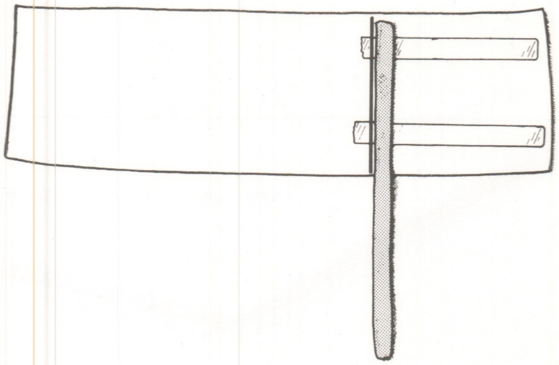
- bottom hems rolled on left and right stabilizer panels.

During the initial opening sequence, the slider can be blown against the bottom of the canopy hard enough to cause part of the stabilizer panel to be pulled down into the grommet. The stop prevents this. It is a metal washer rolled inside a length of webbing and sewn to the stabilizer panel where each suspension line passes. A short tie-in connects the stop to the line.

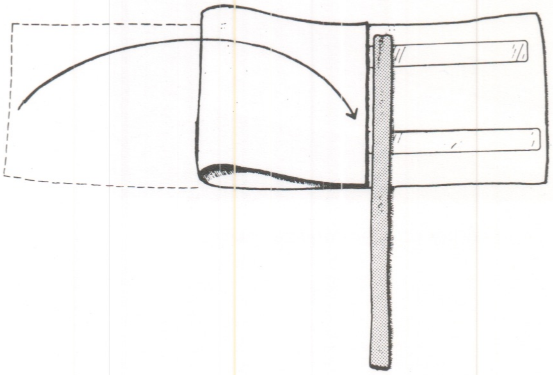




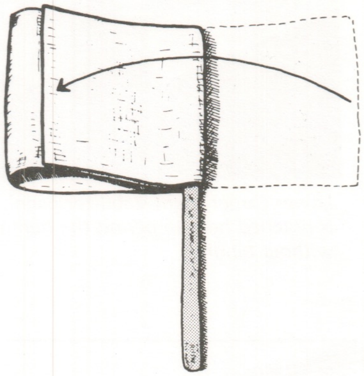
STEP 1 *Position the stop webbing with the guide line to your right. Apply two strips of basting tape as shown, from the right edge to about ¼ inch past the line. Mash the tape down firmly.*



STEP 2 *Remove the paper backing and stick down a tie-in piece along the right side of the line with the extra length pointed down. Do 3 like this. Now do the other 3 exactly the same except have the extra length stick out the top (still along the right side of the line).*

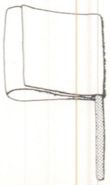


STEP 3 *Fold the left side over and stick it down as shown.*

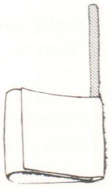


STEP 4 *Fold over the right side as shown and press the whole thing firmly to set the basting tape. The washer will be placed later.*

Completion Checkoff:

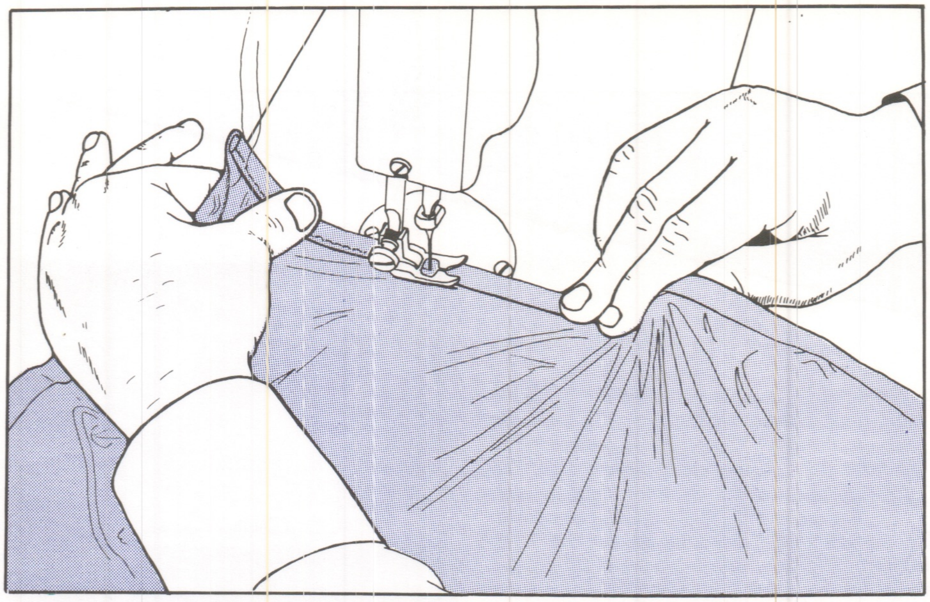


- 3 stops with tie-in down



- 3 stops with tie-in up

Sewing Leading Edges



Look at the sample of hem which is included in the sample kit and refer to the stitch chart for specific detail. Do the inside row of stitching first and space your stitch rows like the samples. Stitch at 7-9 stitches per inch.

All leading edges which were prepared earlier are now sewn. All will take two rows of stitching. Before starting, roll up a sample from scrap and adjust the tension on your machine.

The thickness of the material and the presence of the basting adhesive will require substantially more top tension than just the two or three ply stuff you practiced with.

When you're sewing through the basting adhesive, you'll notice a bit of it accumulating on your needle. This won't cause a problem unless it really piles up. Take the needle out occasionally and clean off the adhesive with your fingers. Refer to the stitch chart for specific stitching patterns on these next sewing jobs.

Completion Checkoff:

- top skins 9 [7]
- bottom skins 9 [7]
- unloaded ribs 9 [7]
- stabilizer panels 2

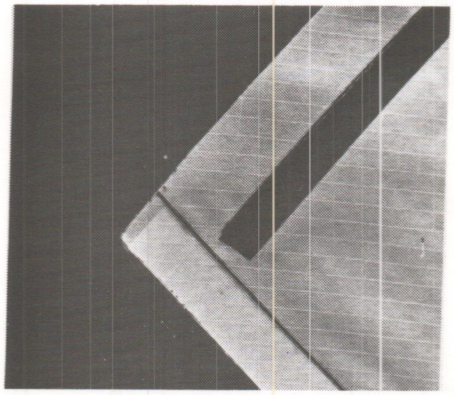
Loaded Ribs Taped

The upper curved edge of the loaded rib is stabilized with red tape as with the unloaded rib except that the tape is placed a little further in from the edge. Pay attention and make sure you get the tape properly positioned.

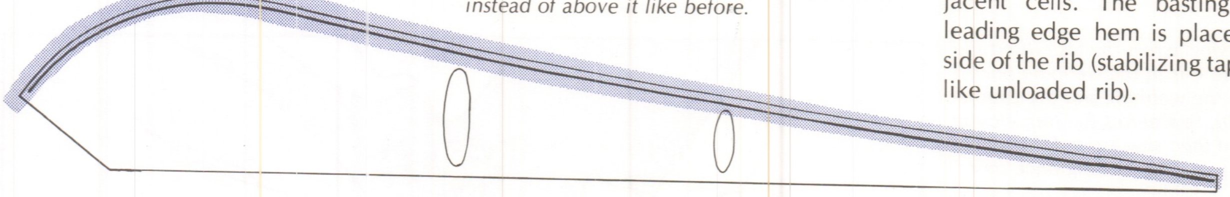
The upper end of the A line is rolled into the leading edge hem instead of the reinforcement tape as before. When finally installed, the line will run through the bottom seam and up inside the leading edge of the loaded rib to end in the top joint of the adjacent cells. The basting tape for the leading edge hem is placed on the right side of the rib (stabilizing tape is on left side like unloaded rib).

Parts Required:

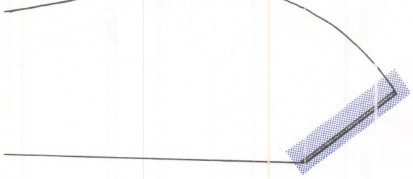
- all loaded ribs 10 [8]
- basting tape
- stabilizing tape



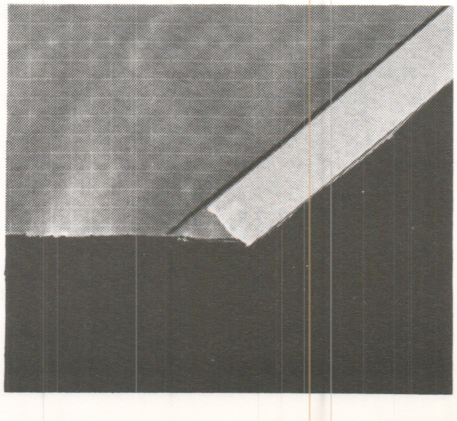
Front top corner of loaded rib (left side) with tapes in place. The basting tape on the other side is visible through the cloth.



STEP 1 *Place a strip of stabilizing tape along the upper curved edge of each loaded rib, left side. This tape goes on similar to the unloaded rib EXCEPT it is placed BELOW the guideline instead of above it like before.*



STEP 2 *On the RIGHT side of the rib, place a strip of basting tape from top to bottom, along the leading edge.*

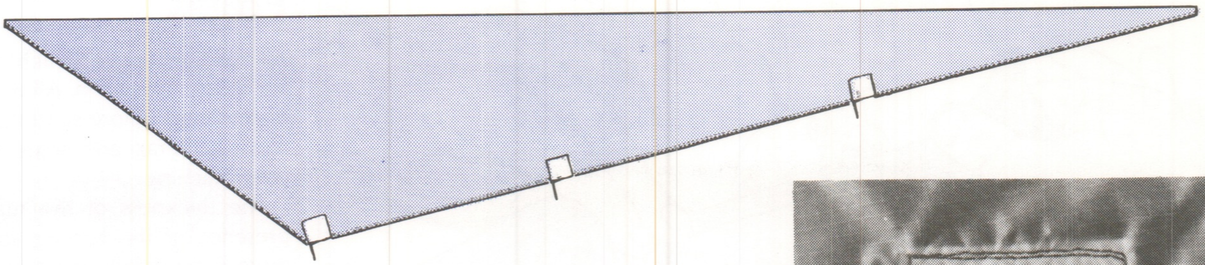


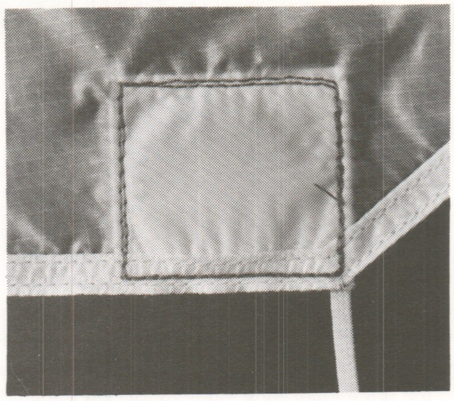
Bottom corner of loaded rib (right side) with basting tape in place.

Completion Checkoff

- stabilizing and basting tape on all loaded ribs 10 (8)

Slider Stops Installed





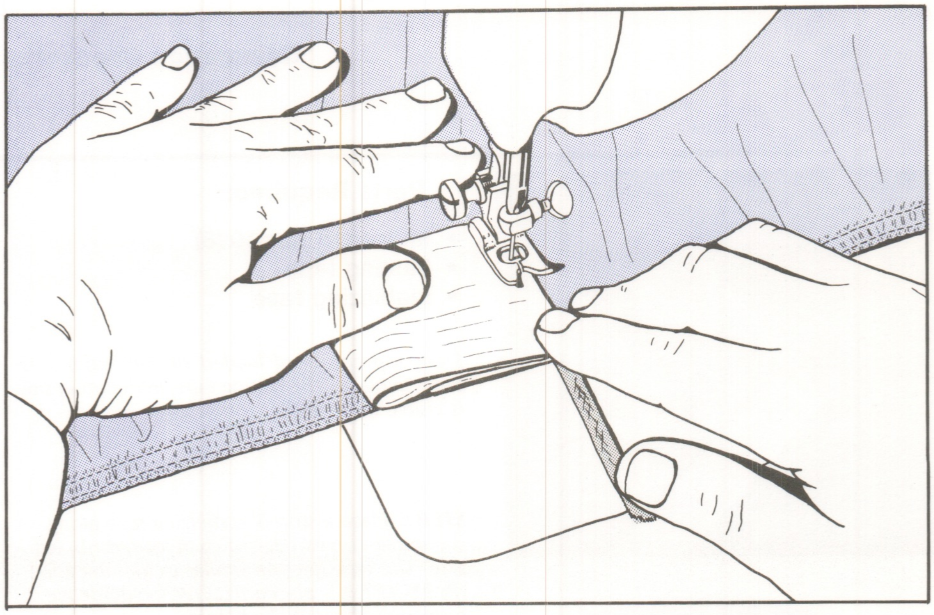
Three slider stops are installed on the inside surface of each stabilizer panel with the tie-in side to the rear. Above, shows positioning of the three stops on the left stabilizer panel. The stops are positioned in a mirror image fashion on the right panel. Right, shows the outside surface appearance after the stop has been installed. The stop is positioned and three sides sewn. The washer is slipped into its pocket and the remaining side is sewn. Refer to the stitch chart.

Parts Required:

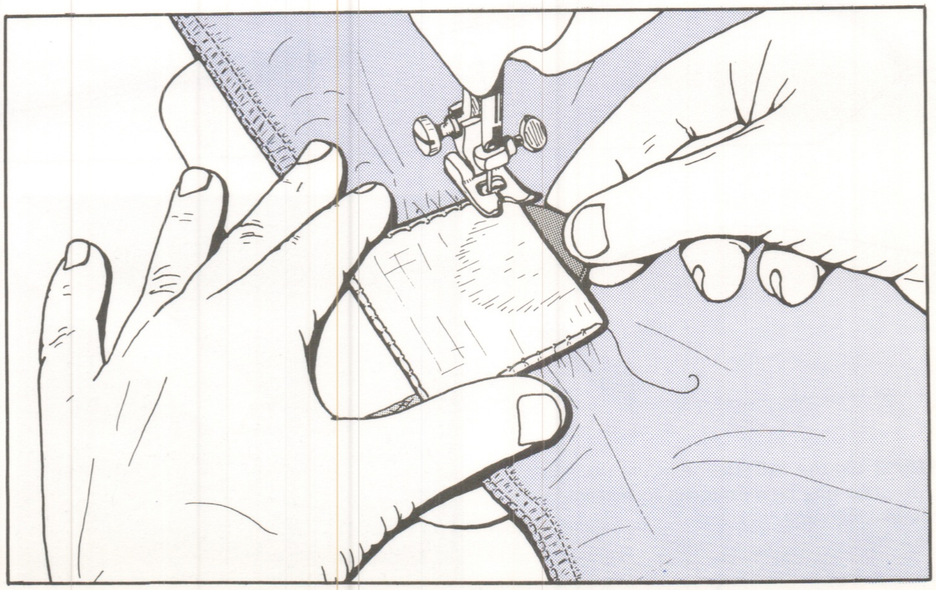
- 6 slider stop pockets prepared earlier
- 6 stop washers
- 2 stabilizer panels

STEP 1 *Position the stop with the tie-in directly over one of the alighnment marks, tie-in side toward the tail. Start sewing at the top of the tie-in, down around and up on the other side.*

Adjust your tension to give you a good stitch along the tie-in. This will mean that when you sew on the thinner parts, your tension will be too tight. Don't worry about it.



STEP 2 *Before sewing across the top, insert the washer, making sure it is in the webbing pocket (not between the webbing and the canopy fabric underneath). Sew across the top, closing off the pocket and then sew around the whole thing once more.*



Completion Checkoff:

- 3 stops installed with washers on left stabilizer panel
- 3 stops installed with washers on right stabilizer panel

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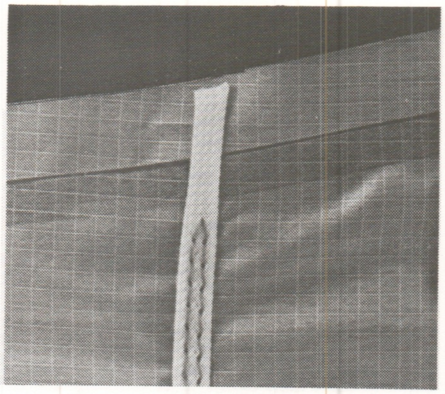
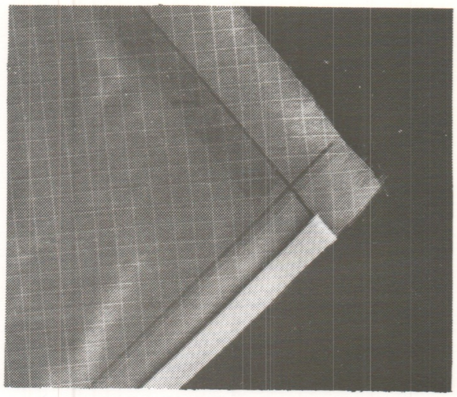
Loaded Rib Assembly

The suspension lines are sewn directly to the loaded rib before it is installed in the canopy. Here you'll prepare these loaded rib assemblies. The 'A' line is rolled into the front edge of the rib to form the reinforced leading edge of that rib and the 'B', 'C', and 'D' lines are sewn onto the rib at the proper location. The cross tape is positioned at the bottom of the rib and is sewn into the bottom loaded seam with the bottom edge of the rib. All this work is done on the canopy right side of the rib EXCEPT the last rib on the right of the canopy. Here the 'A' line is installed in the regular way on the right side but the 'B', 'C', and 'D' lines are sewn to the left side of the rib so they won't end up on the outside of the canopy.



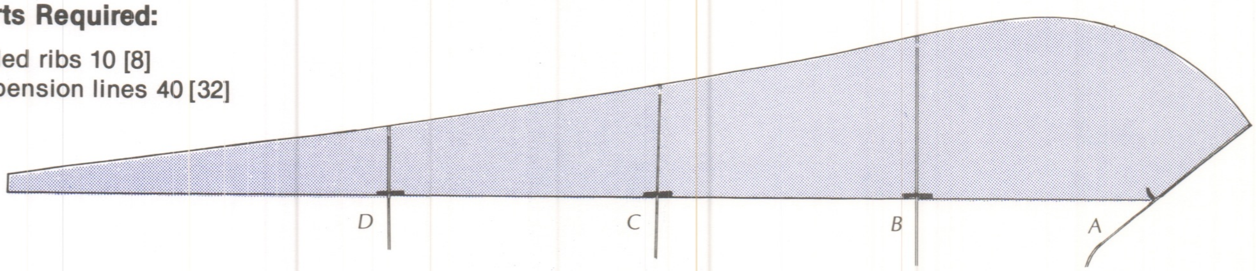
After the B, C, and D lines are sewn into place, the end is cut even with the top edge of the rib. This end is cut with scissors, and left fuzzy.



After the A line is basted into place along the front edge of the rib but before it is rolled into the hem, the end is cut off even with the top of the stabilizing tape (scissors).

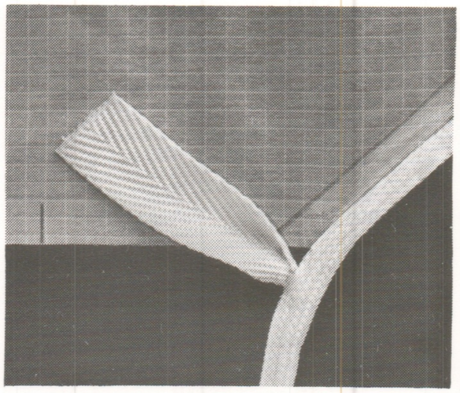
Parts Required:

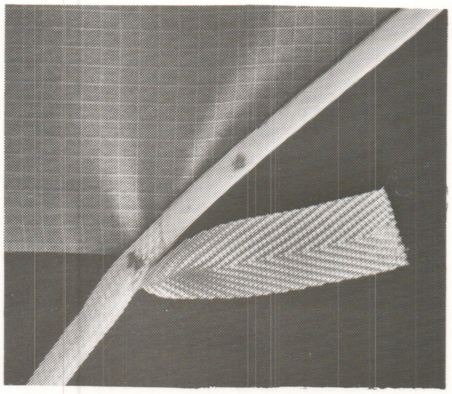
- all loaded ribs 10 [8]
- all suspension lines 40 [32]



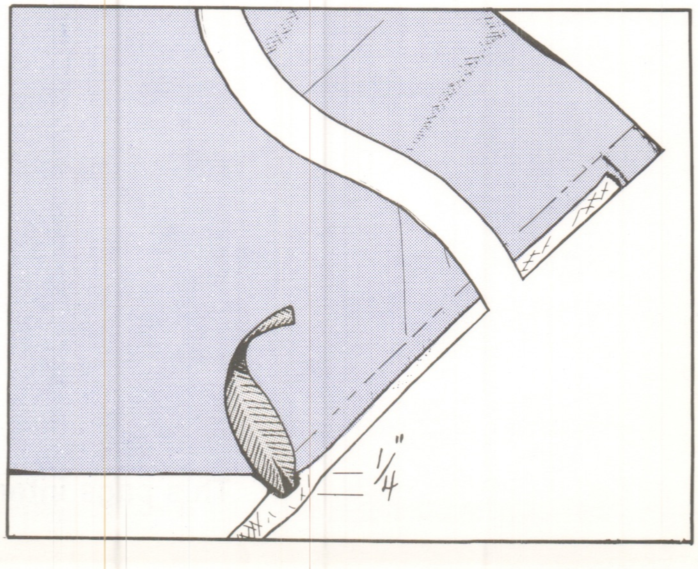
Center right. The A line is placed on the rib leading edge with the cross tape ¼ inch below the bottom edge of the rib.

Far right. The A line after being rolled ½ turn in the hem. The line will be rolled another ½ turn when it is sewn.

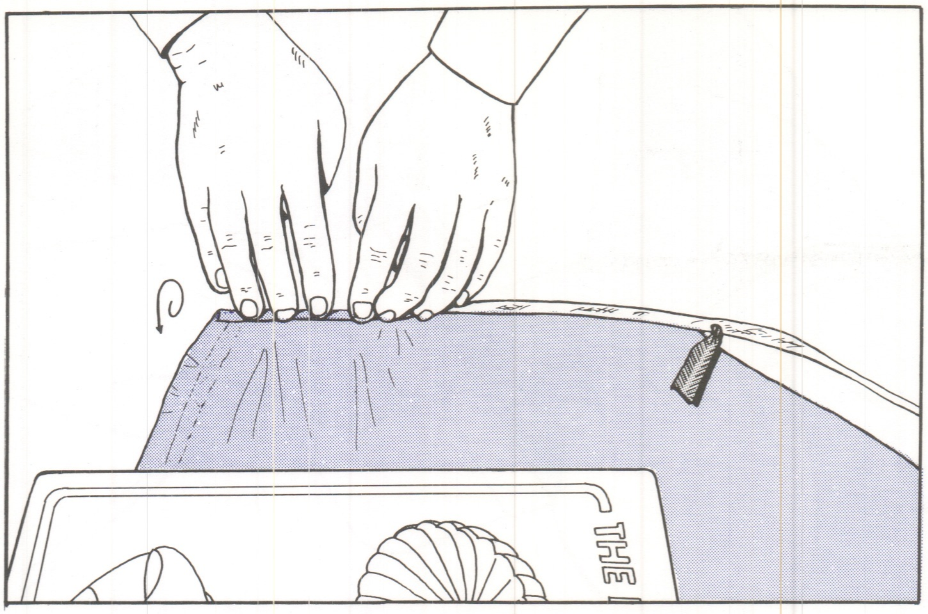




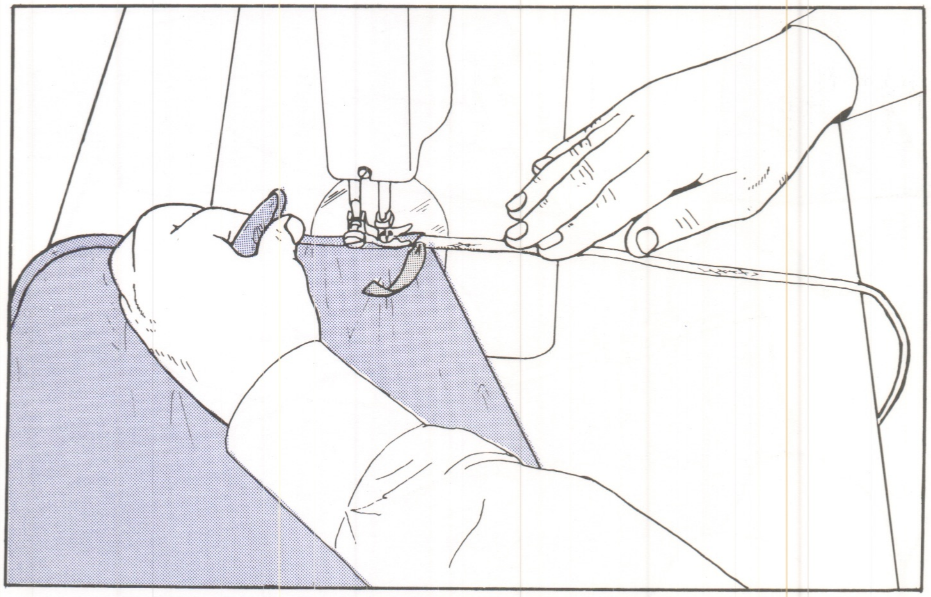
NOTE: Make sure you use the knotted line sets for the two outside ribs. They are the ones which are not cross ported.



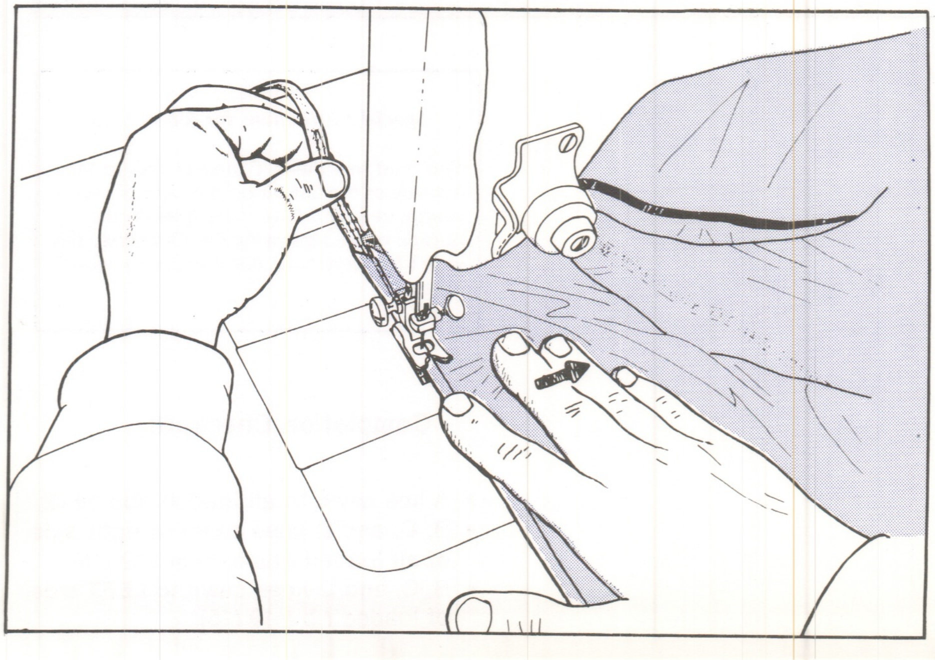
STEP 1 *Remove the basting tape and position the A line along the right front edge of the loaded rib. The cross tape is placed exactly ¼ inch below the bottom edge so that it will roll into the proper position when the hem is rolled. Once the line is in place, the excess is cut off the top so that the line ends even with the guide line for the stabilizing tape.*



STEP 2 *Using a book to help hold things down, roll the hem like you did with the unloaded ribs. The basting tape is so narrow that you'll only be able to roll the hem over once and have it stick, but roll that first turn tight and snug. You'll do the second turn at the machine just before you sew the hem.*

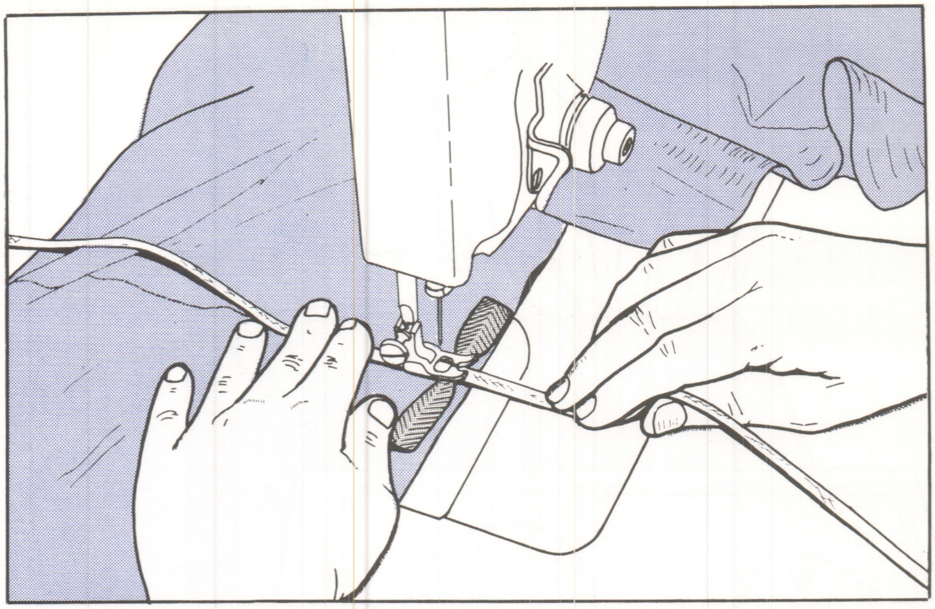


STEP 3 *Refer to the stitch chart for the exact stitch pattern. Roll the second turn to complete the hem and position the part under the needle as shown. You'll start about ½ inch above the cross tape and sew down past the end of the cross tape inside the line and then back up.*

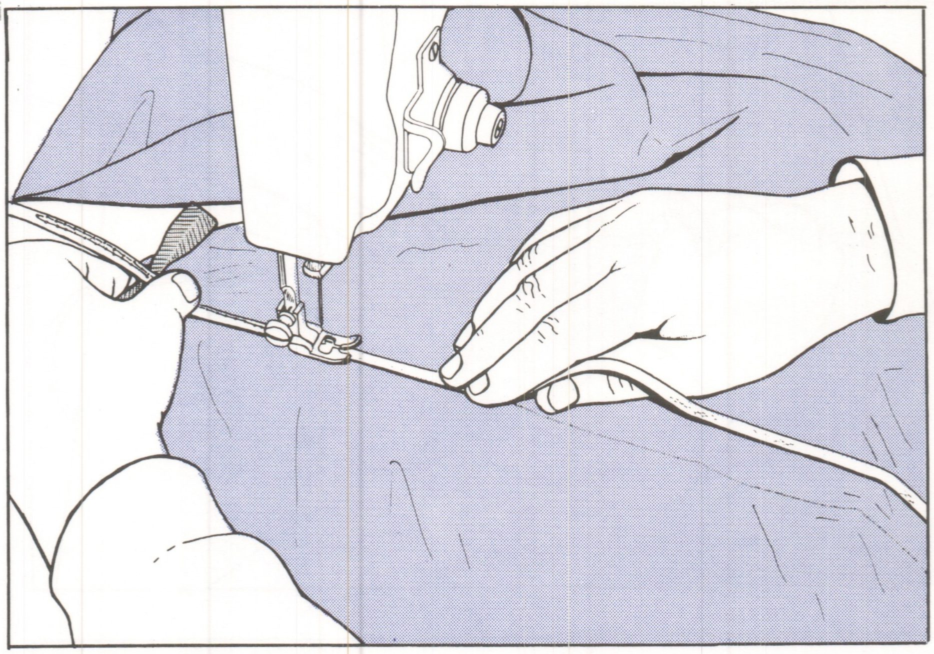


STEP 4 *After turning, sew back up the rolled hem along the inside edge, keeping the rolled hem tight. This hand position works pretty well, use your right index finger to hold the hem straight as it feeds under the needle and use your middle finger to hold the fabric tight to the side thus keeping it tight around the hem. Finish the hem per the stitch chart.*

STEP 5 *Sew the B line to the right side of the rib where indicated by the vertical printed line (printing is on the left side). The stitch pattern is like that of the A line. Position the suspension line on the fabric and start sewing ½ inch above the cross tape, going down below where the tape ends, turn around, sew back up and complete the stitch pattern. See the stitch chart.*



When sewing the second pass (first full pass up the line), position the suspension line over the printed guide line. If the line is hard to see, place the fabric on a white surface and trace the line on the right side with a pen.



STEP 6 *Install the C line on the rib.*

STEP 7 *Install the D line on the rib.*

NOTE: Sew B, C, and D lines in place with code marks for cross tape work down against the rib so you can't see them.

Special Instructions for Rib *#19 (15)*

You must sew the B, C, and D lines to the left side of the last rib on the right of your canopy or you'll have these lines on the outside of the right wing tip. Of course, this won't hurt anything, but it definitely won't be cool.

Completion Checkoff:

- A line sewn to all loaded ribs 10 [8]
- B, C, and D lines sewn to right side of all loaded ribs except #19 [15].
- B, C, and D lines sewn to **LEFT** side of loaded rib # 19 [15].

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'I' Beam Assembly

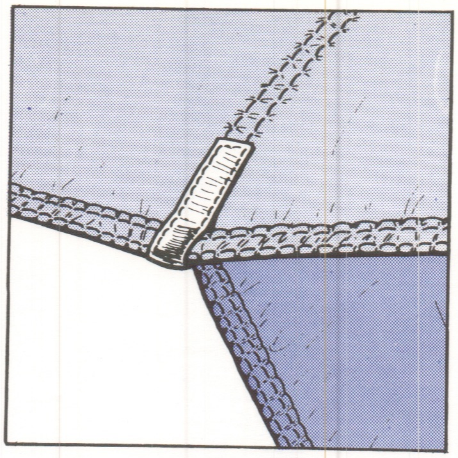
Now it's time to start putting your canopy together. The first job is mating the upper and lower skins with the unloaded ribs to form the 'I' beam assemblies. First, you'll sew the top stabilized edge of the unloaded rib down the centerline of the top skin. Once you have the first row of stitches in place, you'll remove the stabilizing tape, turn the assembly over and sew the second row. You'll repeat the procedure with the bottom edge of the rib and the bottom skin. It's best to do the top seam first as it is the most difficult and the job is not complicated by having to drag along an already installed bottom skin. After you have the rib in place, you'll install a confluence wrap around the joint, top and bottom, where the leading edges of the rib and skins meet. This gives extra strength here where the seam ends (the end of a seam is usually its weakest point). The trickiest part of building your canopy is sewing the curved top edge of the rib to the straight centerline of the skin. The stabilizing tape helps because it lets you pull a few inches of that curved edge out straight for sewing without stretching the bias cut out of shape. Sewing a curved line to a straight line can result in some funny business when you get to the end. To make sure you're getting the parts down symmetrically, keep a close eye on the registration marks along the seam. If things start to get out of alignment, you'll see it right away and be able to take corrective action.

Each seam has a primary and secondary row of stitches. The primary is that row which takes the major portion of the load, the row which is most critical. Take a look at the seam diagram, you'll see that the row which does most of the work is the one you sew on the second pass. Primary does not necessarily mean first to be sewn.

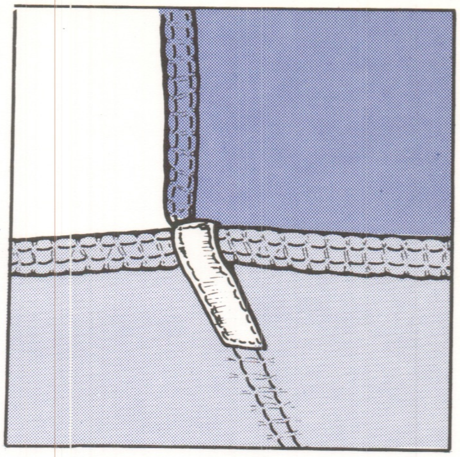
After you have the top skin in place, you'll sew the packing tabs on where indicated. These little tapes give you a convenient hand hold for packing.

Parts Required:

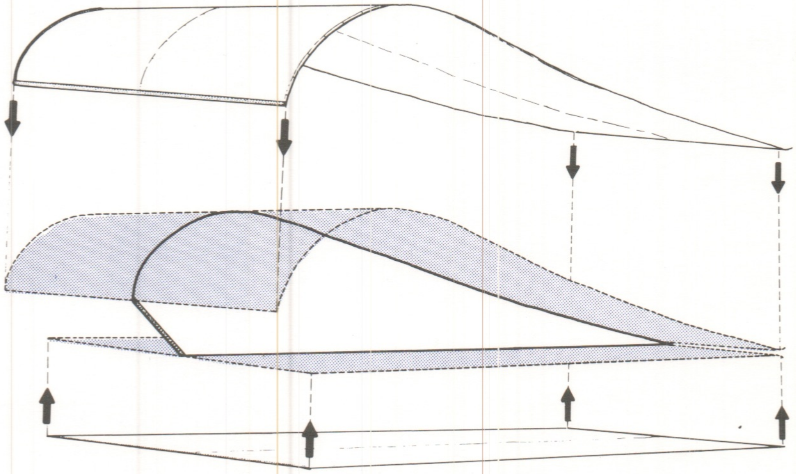
- all unloaded ribs 9 [7]
- all top skins 9 [7]
- all bottom skins 9 [7]
- reinforcing tape 2 - 3' lengths



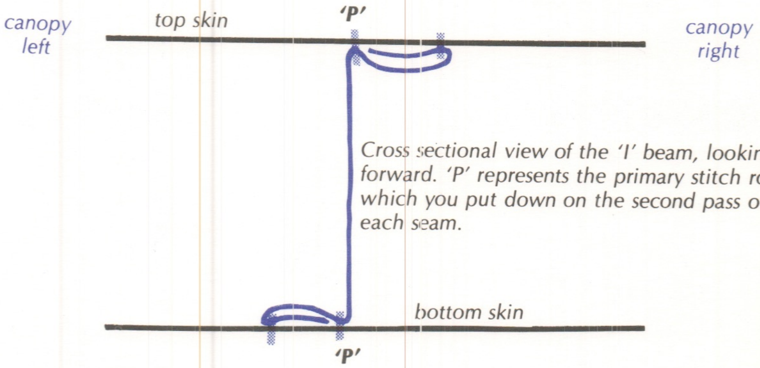
Top skin-rib joint. A reinforcing confluence wrap is sewn around the joint where the leading edges of the rib and skin meet to strengthen this weak point.



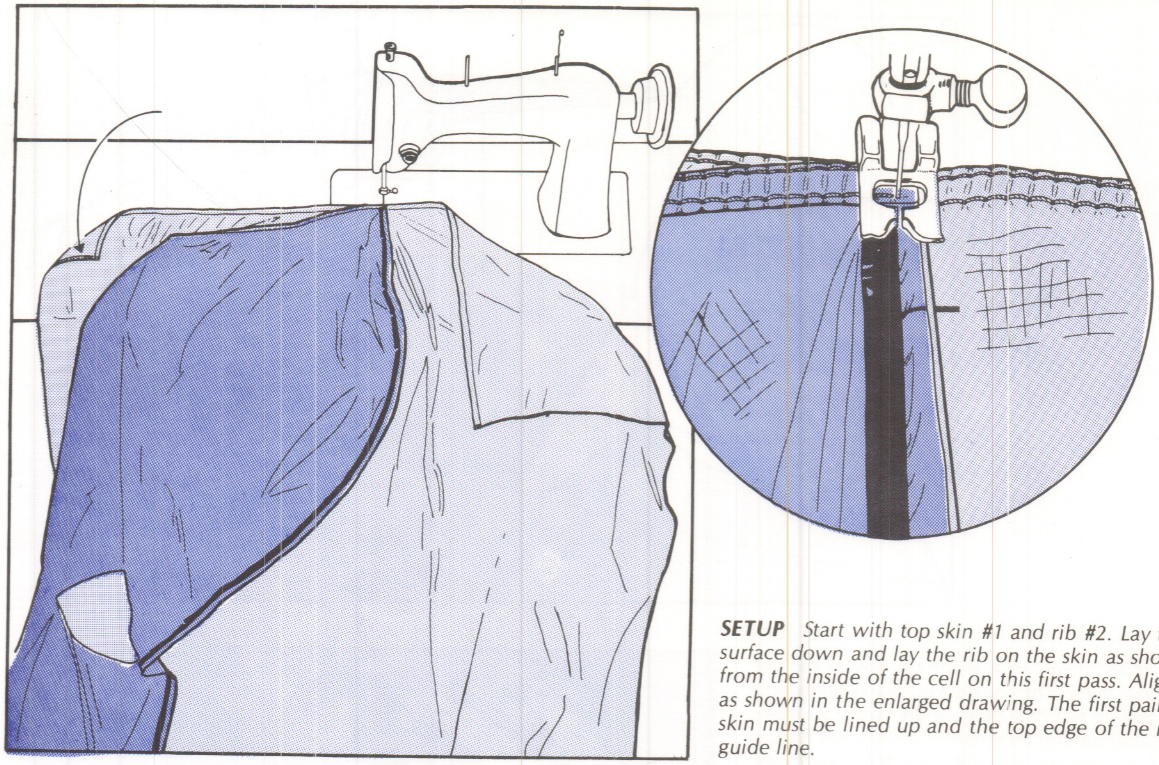
Bottom skin-rib joint with reinforcing confluence wrap.



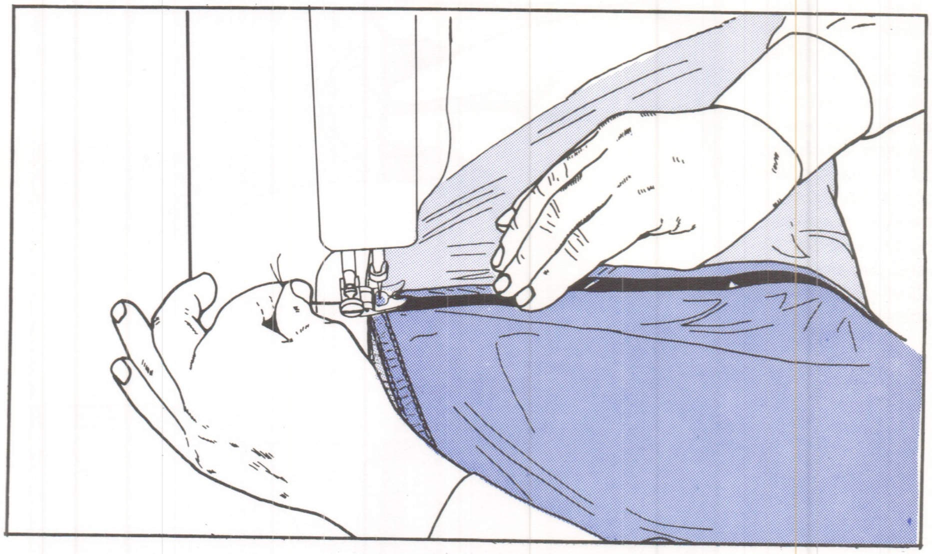
Top and bottom skins are sewn to an unloaded rib to form an I beam assembly.



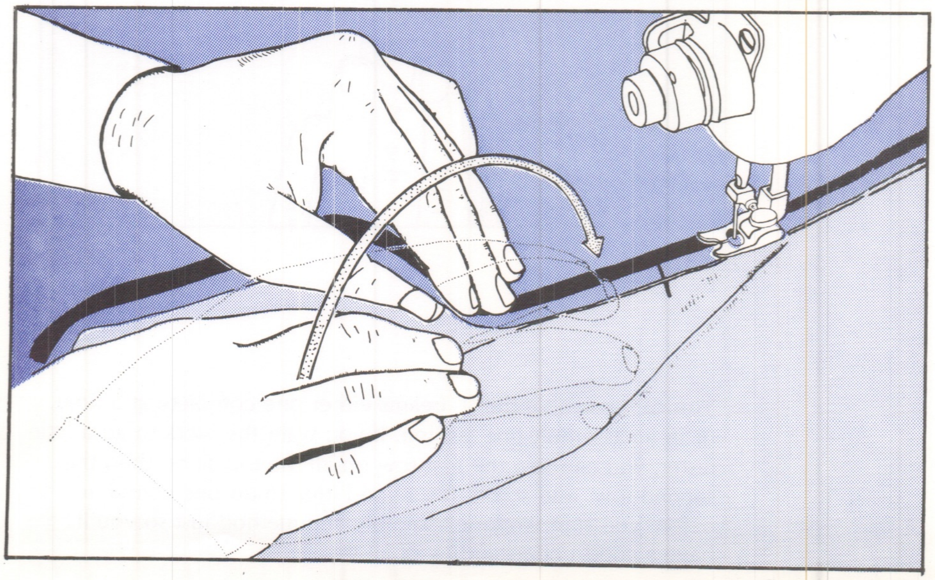
Cross sectional view of the 'I' beam, looking forward. 'P' represents the primary stitch row which you put down on the second pass of each seam.



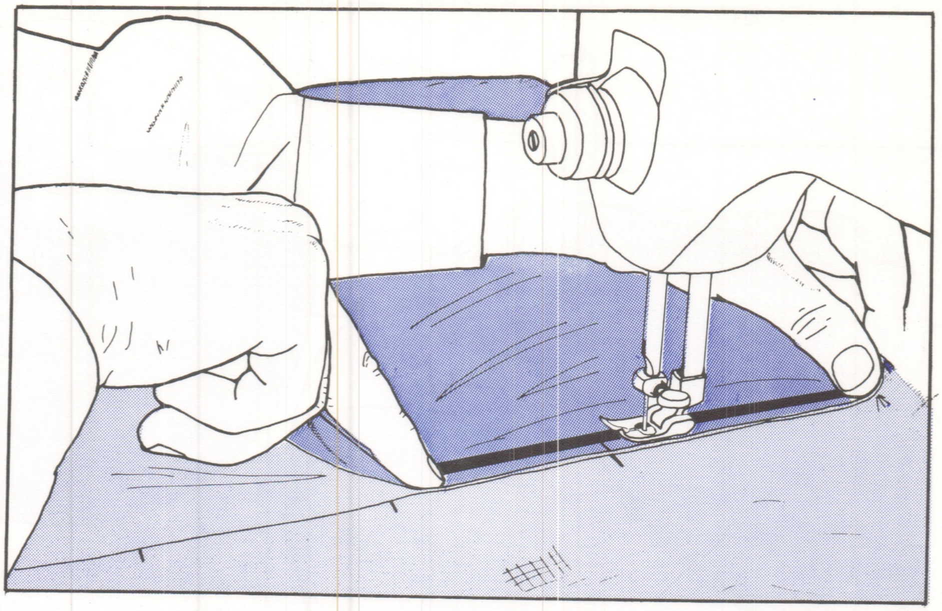
SETUP Start with top skin #1 and rib #2. Lay the top skin outside surface down and lay the rib on the skin as shown. You'll be working from the inside of the cell on this first pass. Align the top edge of the rib as shown in the enlarged drawing. The first pair of marks on the rib and skin must be lined up and the top edge of the rib must be along the guide line.



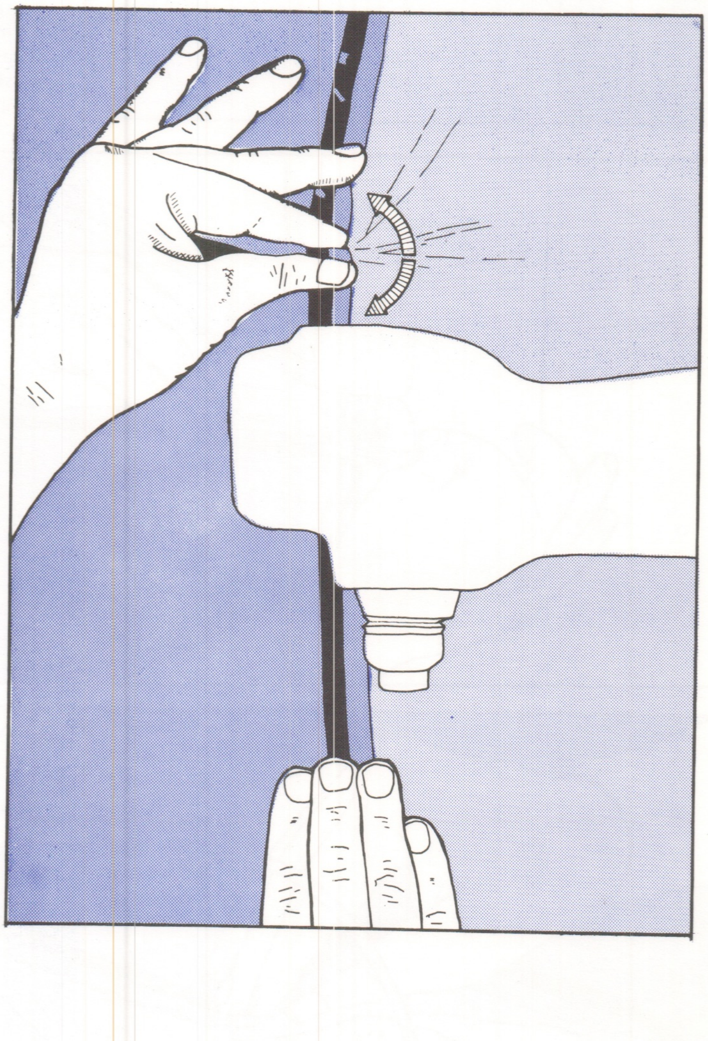
STEP 1 Sew the first row of stitching from the leading edge hem to one-half inch past the end of the rib at the tail. Keep this row along the edge of the stabilizing tape, keep the edge of the rib lined up with the guide line, and keep the registration marks even as you go. After you've finished this stitch, pull off the stabilizing tape.



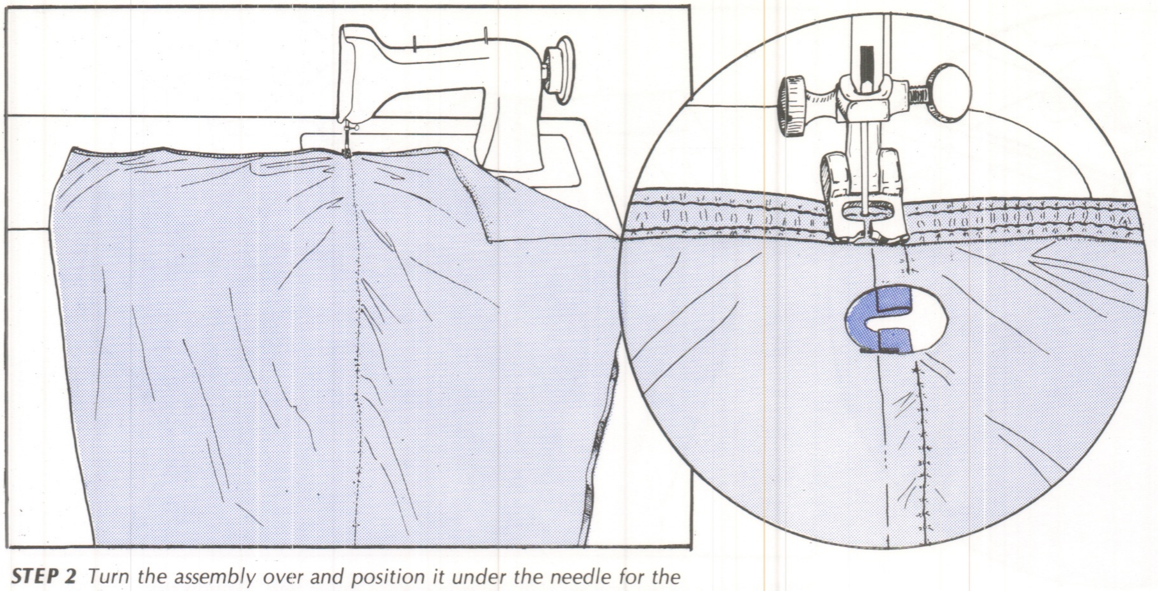
The stabilizing tape allows you to pull out straight, short lengths of the curved edge so it can be lined up with the guide line on the skin and sewn down. This drawing shows a common method. With your right hand, gently pull the skin fabric smooth and straight and with your left hand, pull the curved edge straight and place it along the guide line. While holding the two pieces down with the left hand, bring the right hand around and place it on the work just ahead of your left hand and then reach around with the left, grasp the work behind the needle and sew this short section holding the whole business in slight tension. Where the curve is the greatest, your sewing will be in short lengths while on the long back side of the rib, you'll sew much more at a time.



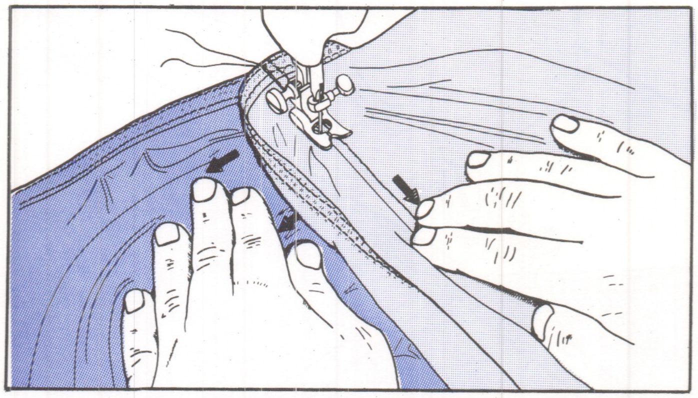
The two pieces must go together evenly so that the tail end of the top and bottom skins will come out even. The registration marks allow you to see if the seams are getting out of alignment and you can make adjustments right then to correct any irregularity. It's normal for the marks to get off a little and you can use the methods illustrated to get things back straight. If you find the skin is going through the machine quicker than the rib, you can pull it much tighter each time you line up the two parts for sewing. In the drawing above is a method for stretching out the rib in case it is creeping forward on the skin. Here, you hold the rib in your right hand and pull it fairly tight and then set it down on the unstretched skin and sew a short distance. The method to the left can work both ways. If you hold the seam between left thumb and index finger so that the stitch row comes even with the back of the thumbnail, you can rotate this grip about the axis of the stitch row. If you rotate the thumb forward, you will cause the skin to advance relative to the rib. Rotate the thumb back and you tend to cause the rib to advance against the skin. This business is subtle and you shouldn't expect, or try, to correct an alignment problem in a short distance, just get it straight by the time you get to the end of the rib.



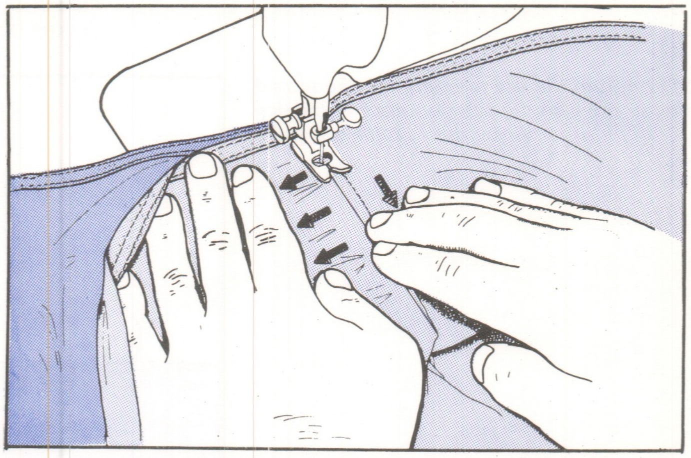
You can assemble the 'I' beams either one complete at a time, or in an assembly-line fashion. If you want the work to go a little faster, you can sew the first row on all the top skins, then the second row, and so on. It's a good idea to do one complete before you start working assembly-line method just so you'll have a good understanding of all the steps.



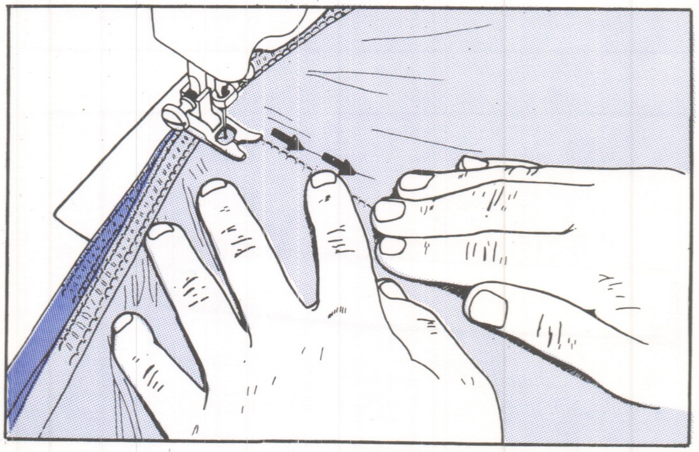
STEP 2 *Turn the assembly over and position it under the needle for the next stitch row. When properly positioned, the rib is lying off to the left underneath the skin and you are sewing on the outside surface of the top skin. Start at the hem and sew to ½ inch past the end of the rib. This row should be about ¼ inch over from the one sewn before. If everything is going together exactly right, you'll be sewing directly on the guide line. The most important thing is to keep the ¼ inch spacing whether or not it's on the guide line.*



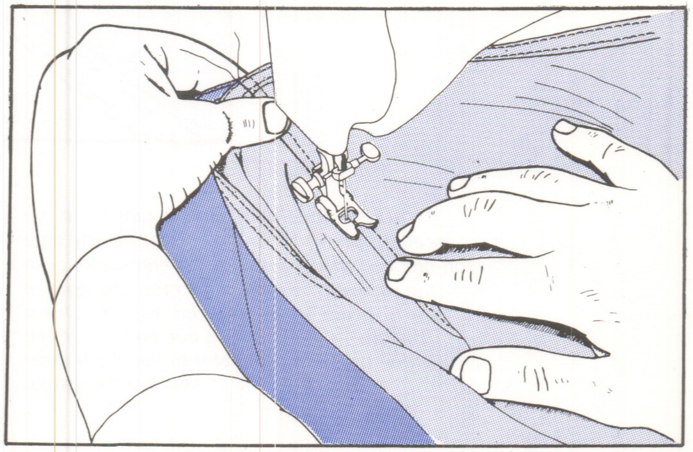
1. *The main concern here is that the seam goes down flat with no bunching up of fabric between the two rows of stitching. These drawings show one way to keep the seam flat. The first step is to fold the top skin over and pull the rib out flat while pulling the seam tight with the right hand.*



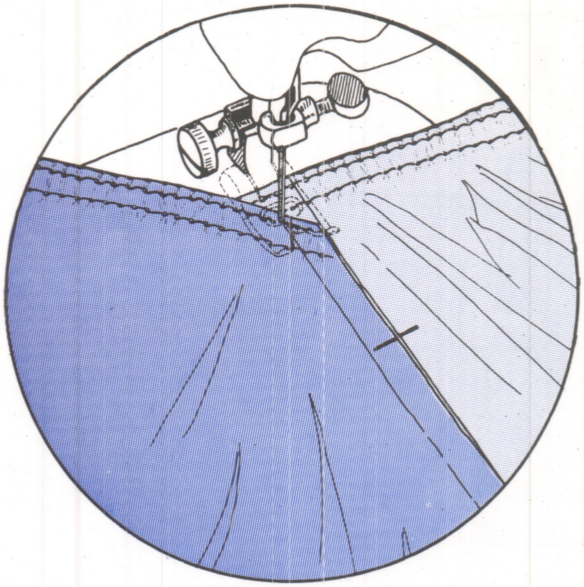
2. *Lay the top skin back over and pull it flat while keeping tension on the seam with the right hand.*

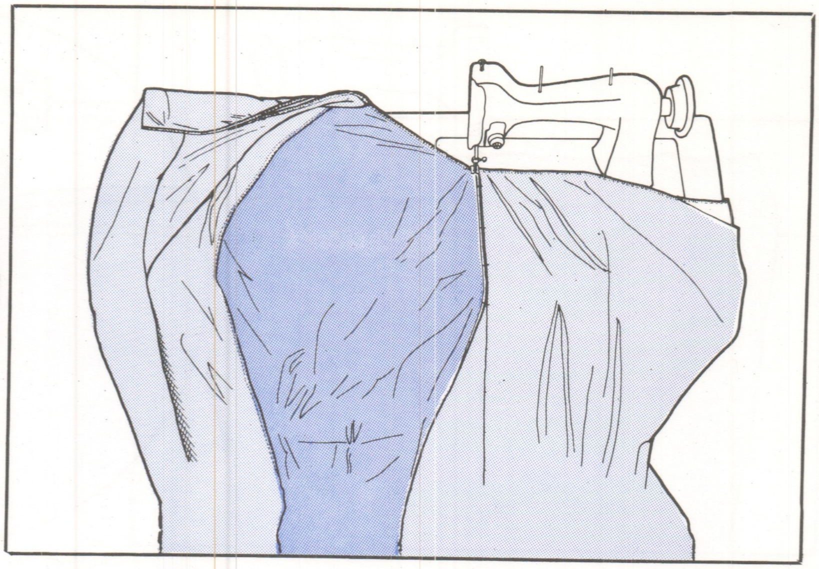


3. *Hold everything flat by maintaining tension with the right hand and run your finger down the area you are about to sew to press the seam as flat as you can.*



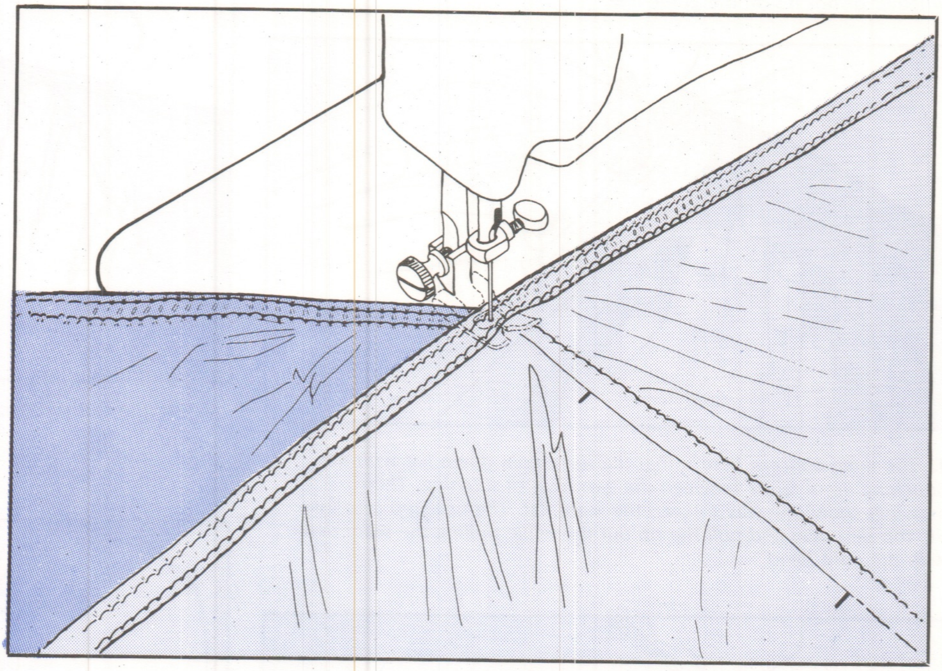
4. *Sew that section prepared and repeat the process. This will be slow going at first but you'll speed up when you get to the straight back side of the rib. Your seam will look puckered but to make sure you haven't gotten too much material between the rows, grasp the material on either side of the seam and pull. If you see some puffy, loose places between the rows, the area needs rework. See the photos on page 59 for a proper seam.*



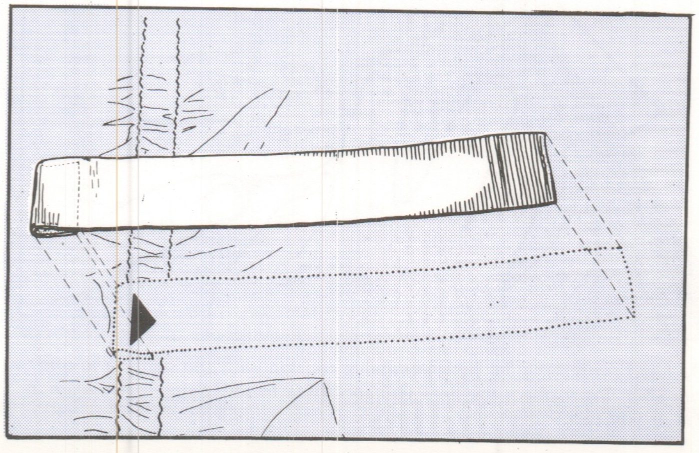


STEP 3 Lay out the bottom skin, outside surface down and position the bottom edge of the rib along the guide line on the skin. The bottom seam is done like the top except that you sew along the guide line at the bottom edge of the rib instead of guiding on the stabilizing tape as with the top seam. Sew from the hem along the edge to about ½ inch past the end of the rib.

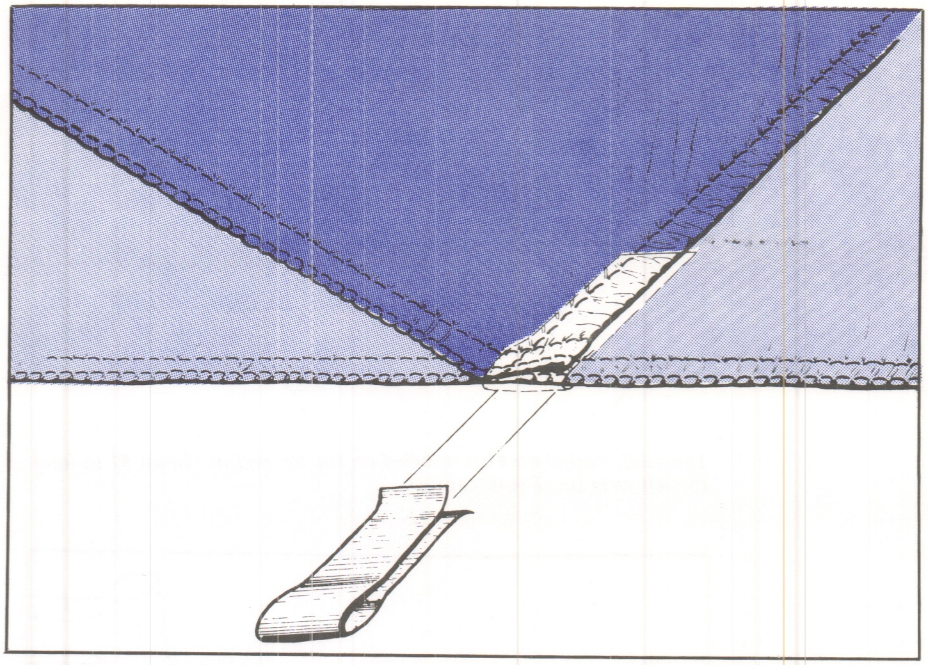
STEP 4 Turn the skin over and sew the second row, stitching on the outside surface of the skin as you did with the top seam.



STEP 5 Install the packing tabs (2) in the locations marked. Place a strip of basting tape on one end of tab and fold the end under as in the drawing. Sew the tab to the top seam of the 'I' beam in the positions marked. Orient the tab so that the long free part lies in the direction of the arrow. Refer to the stitch chart for sewing details.



Note: when you're sewing 'I' beam #5 (4) ignore the pilot chute attach parts installed earlier on the skins and rib of this cell, they'll automatically fall into position as the parts are assembled.



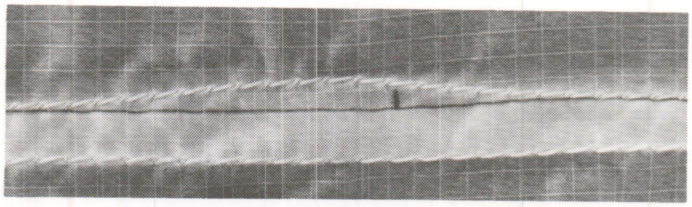
STEP 6 *Install the confluence wraps around the leading edge joints. Cut two strips of reinforcing tape 3 inches long, remove the paper backing and stick the tapes around the joints as shown. Your tape should wrap evenly around and be centered on the two rows of stitching of the seam. Sew according to the stitch chart pattern.*

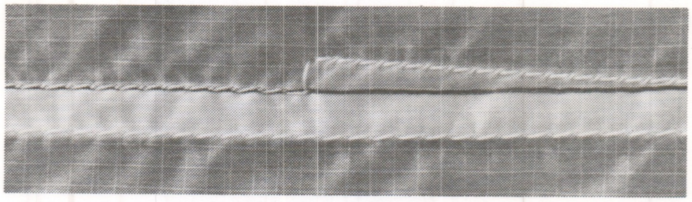
STEP 7 *Complete the pilot chute attach system. To connect the attach loop, locate the center of the vertical shunt where it is sewn to the top skin on the inside and mark this point directly above on the doubler patch. Position the attach loop directly over this point and sew according to the stitch chart. This is about the thickest part you'll sew on your canopy so you'll have to crank in a bunch of top tension.*

Next, sew the vertical and horizontal shunts together where they meet in the seam. Refer to the stitch chart. When you're sewing these parts, make sure the rib is lying off to the side underneath.

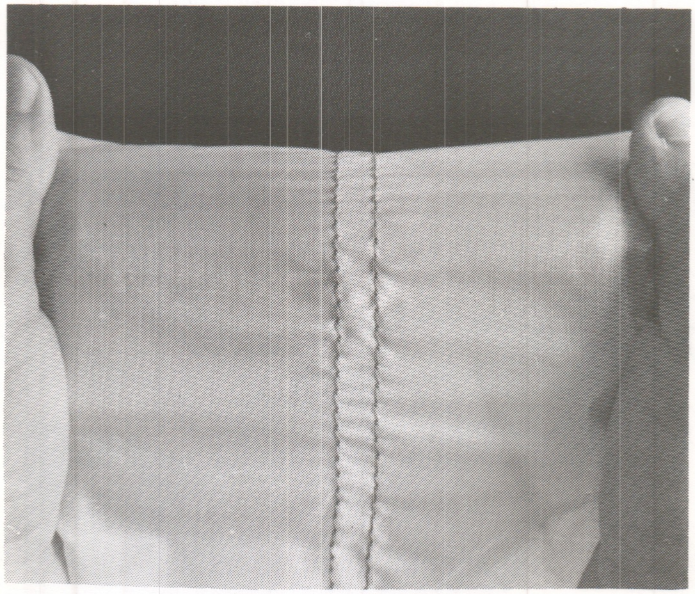
Completion Checkoff

- all 'I' beam assemblies complete•9 [7]
- attach loop sewn in position
- vertical and horizontal shunts sewn together

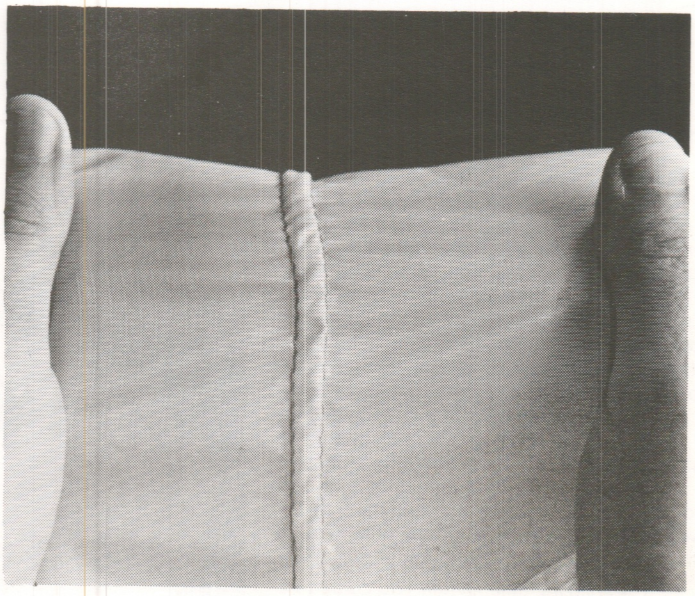




IMPORTANT NOTE: *If you drift off course as you're sewing , you should* ***gradually*** *head back in the right direction. The top left photo shows the right idea. The quick, dirty and wrong way is to jump over all at once as you see middle left. This creates a stress point and weakens your assembly. Your canopy absorbs a tremendous amount of stress during opening and the seams can carry a surprisingly high load if the entire seam can absorb the stress evenly, without unexpected concentrations. This is most important on the primary stitch row of the loaded ribs.*



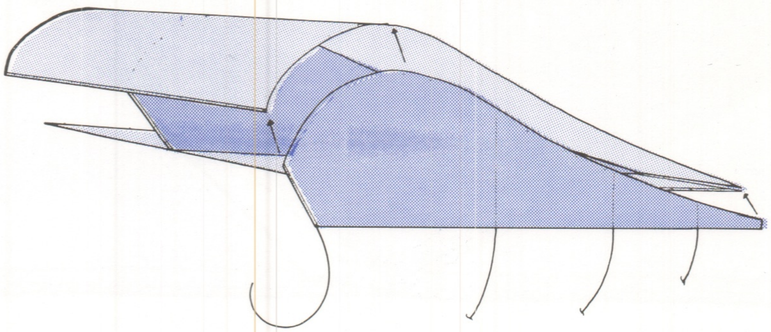
Your seams should be as flat as possible so that spanwise stress across the seam is carried by the skin and not parts of the seam. Check your seam by pulling the fabric spanwise and see if the fabric between the two rows of stitching gets tight. Above, the seam is OK.



This improper seam has loose, puffy areas remaining between the rows when the fabric is stretched. Ideally, both sides of the seam should be tight, without extra material between the row and with a little practice, you'll be able to get the rib and skin fabric evenly distributed in the seam.

Loaded Rib # 1

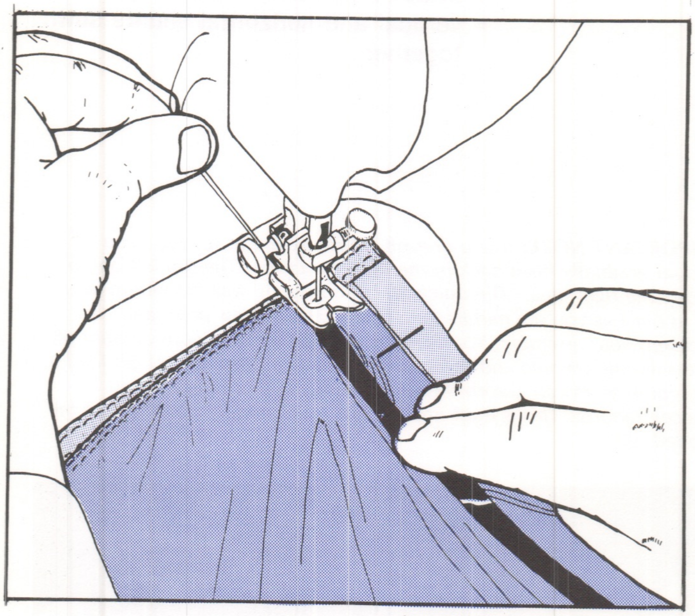
All loaded ribs are installed in the same way with the exception of some slight variations in the two end ribs. To install the left rib, you'll first sew the top edge of the rib to the top skin with two rows of stitching. Then, you'll position the bottom edge of the rib along the guideline on the bottom skin, insert the suspension lines through the seam and close this seam with two rows of stitching. Last, you'll sew confluence wraps around the leading edge joints.

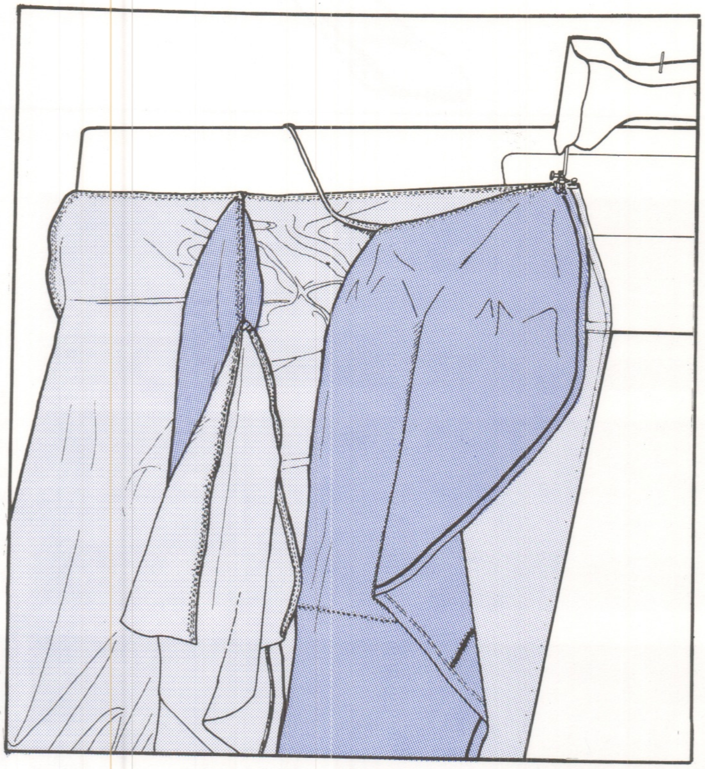


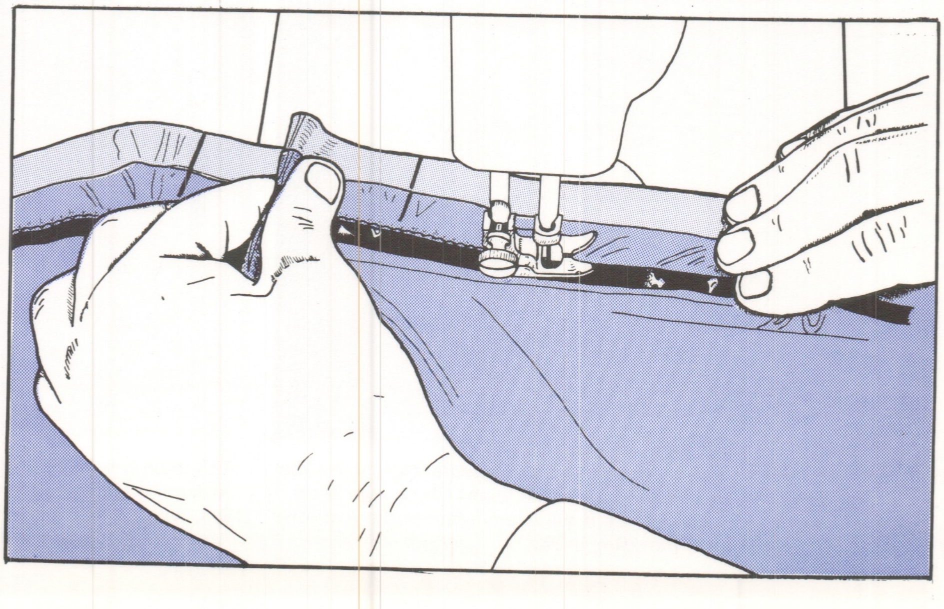
The solid, loaded rib #1 is installed on the left end of I beam #1 to form the left wing tip of your canopy.

Parts Required:

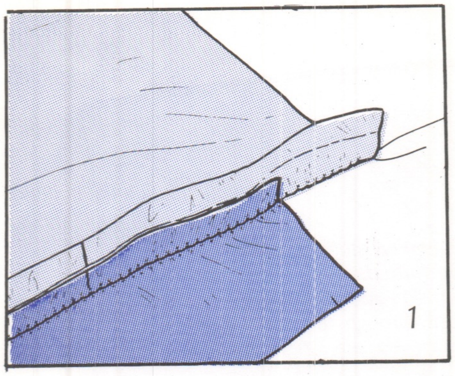
- fid
- I beam assembly #1
- loaded rib assembly #1
- reinforcing tape

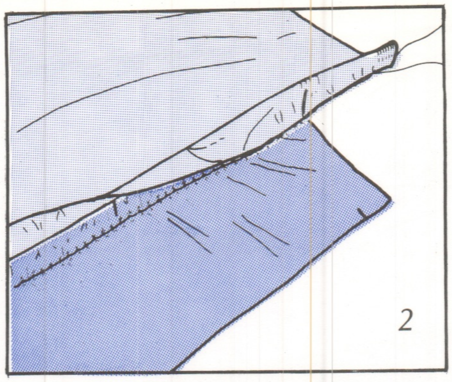






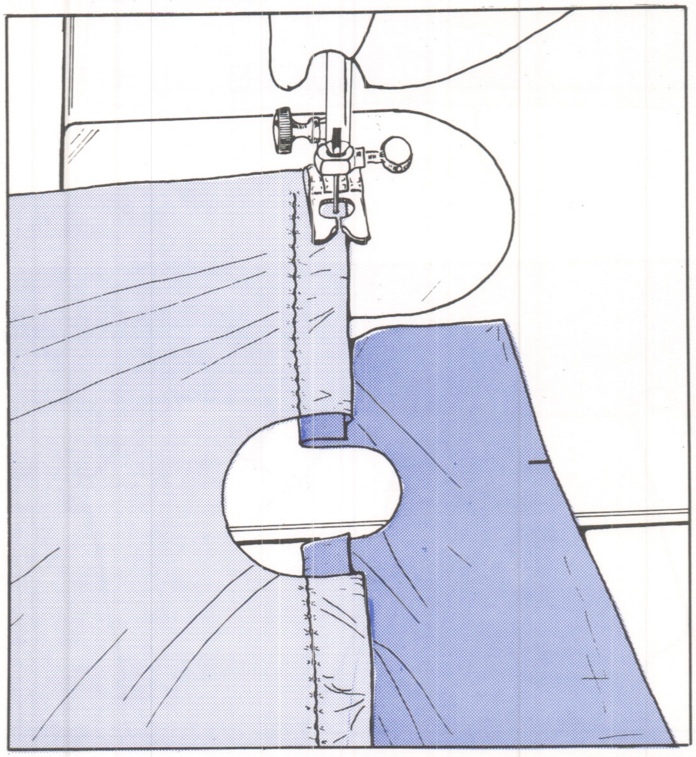
STEP 1 *Sew the rib to the top skin with the first pass of stitching. This stitching is the primary, load bearing stitch of the top seam. For this first pass, you'll sew the rib about ½ inch in from the edge, inside surface of the top skin. Position the parts under the needle as shown. The outside surface of the top skin is down, the rib is positioned with its left side up (stabilizing tape up). To start sewing, place the top edge of the rib along the guide line printed on the skin and align the first registration marks. Set the needle at the top edge of the stabilizing tape and use that edge as a sewing guide as you did on the unloaded ribs. Sew from the leading edges of the two parts all the way down the tape past the tail of the rib, to the trailing edge of the skin. Remove the stabilizing tape. When you come to a suspension line, increase top tension, sew over it, return tension to normal and continue. Right shows one method of controlling the fabric during sewing.*



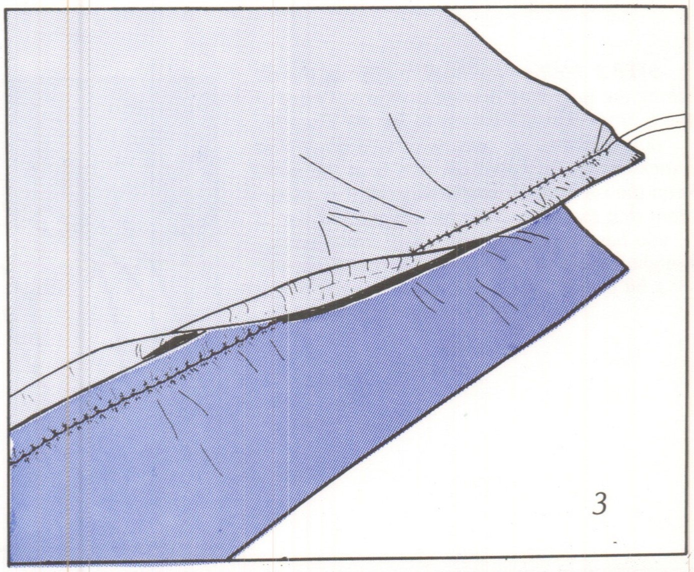


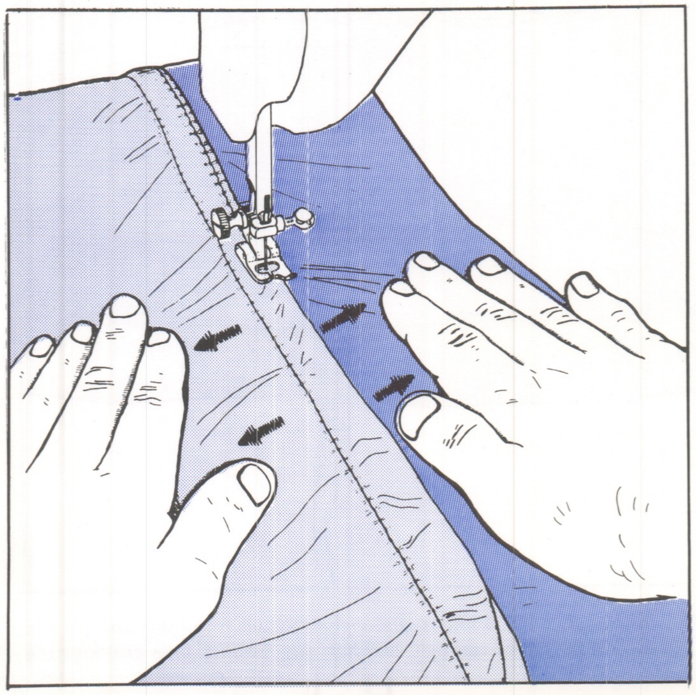
STEP 2 *Starting from the tail end, fold the seam and sew the second row of stitches. Place this row about 1/8 inch in from the edge and start it even with the point where the previous row was stopped. Fold and sew to the nose. Look at the sample marked 'top loaded seam', it is identical to this seam except that it has an extra piece of cloth folded into the seam.*

FOLDING THE SEAM 1) Lay the tail end of your assembly on the table as shown in the upper left with the skin to your left (inside surface down) and the rib to your right. 2) Fold the edge of the skin down to the stitch row. 3) below, Fold the seam down flat against the rib and place it under the needle. You now have the two pieces mated by an interlocking seam.

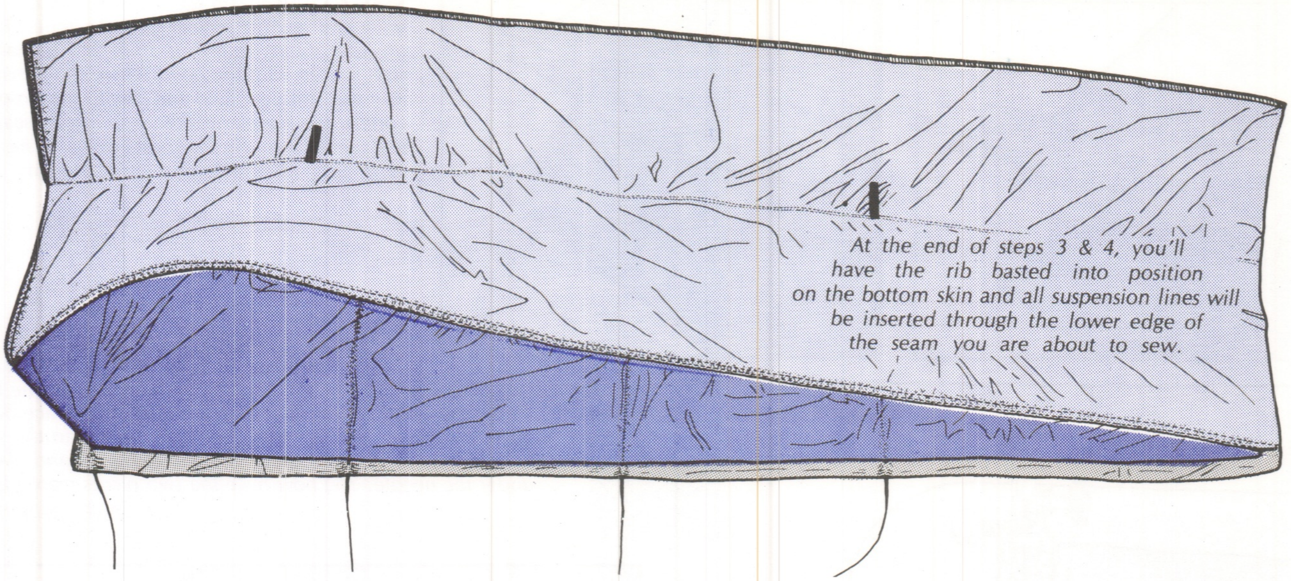


Folded seam, under the needle and ready to be sewn. Sew from this point to the nose, folding as you go.



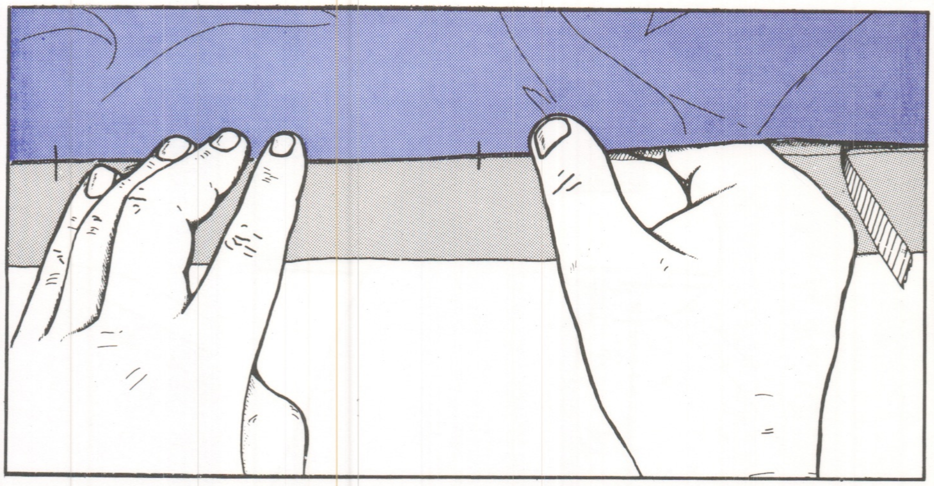


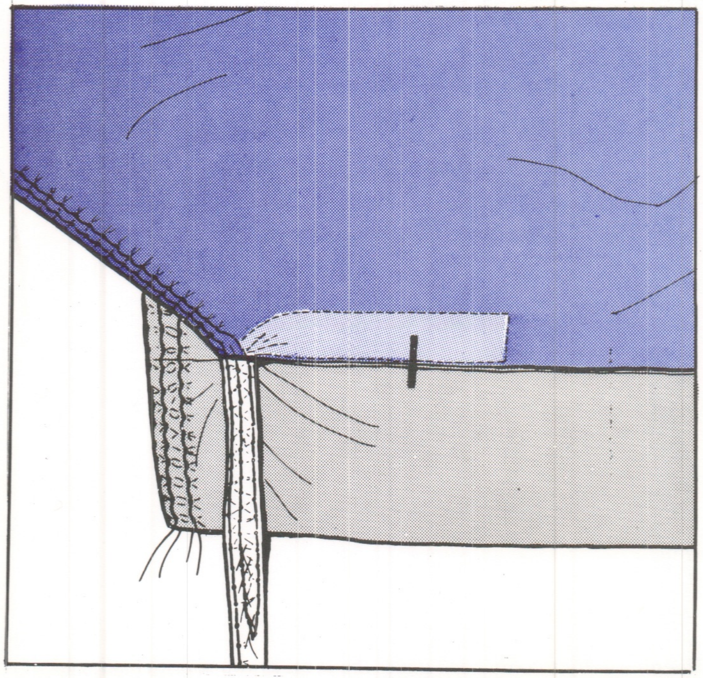
The rib will try to ooze back under the seam as you sew it creating a messy business on the other side. To avoid this, constantly pull the two parts tight as you're folding and sewing. Keep that seam tight! When you come to a line, go across it slowly, using the one hand feeding method, turning the machine by hand.



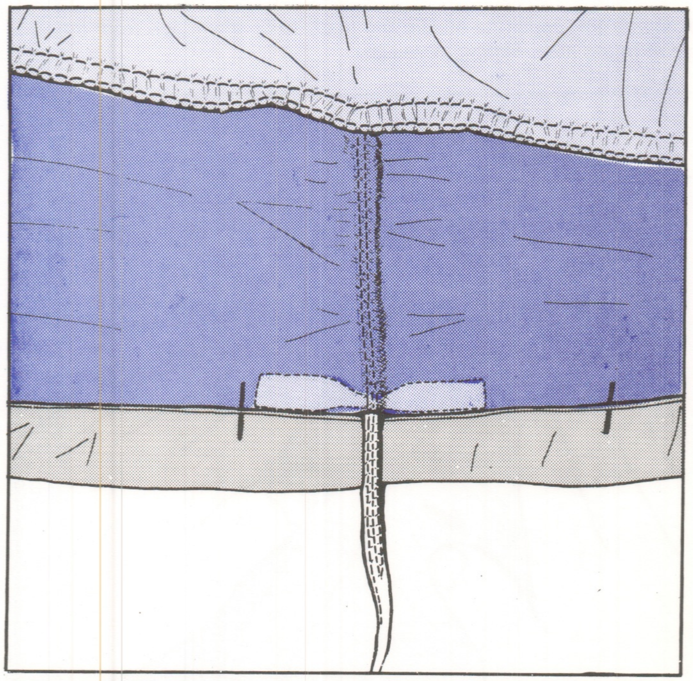
At the end of steps 3 & 4, you'll have the rib basted into position on the bottom skin and all suspension lines will be inserted through the lower edge of the seam you are about to sew.

STEP 3 *Position the bottom edge of the rib along the guideline printed on the left edge of the bottom skin. It's easiest to lay the assembly out, bottom skin, outside surface down and stick the rib into position starting at the nose. Keep the registration marks aligned. It is important that the cross tapes be straight and flat. If you have trouble getting them stretched out straight and tight between the skin and rib, use a bit of basting tape to hold the ends of the cross tape to the rib.*

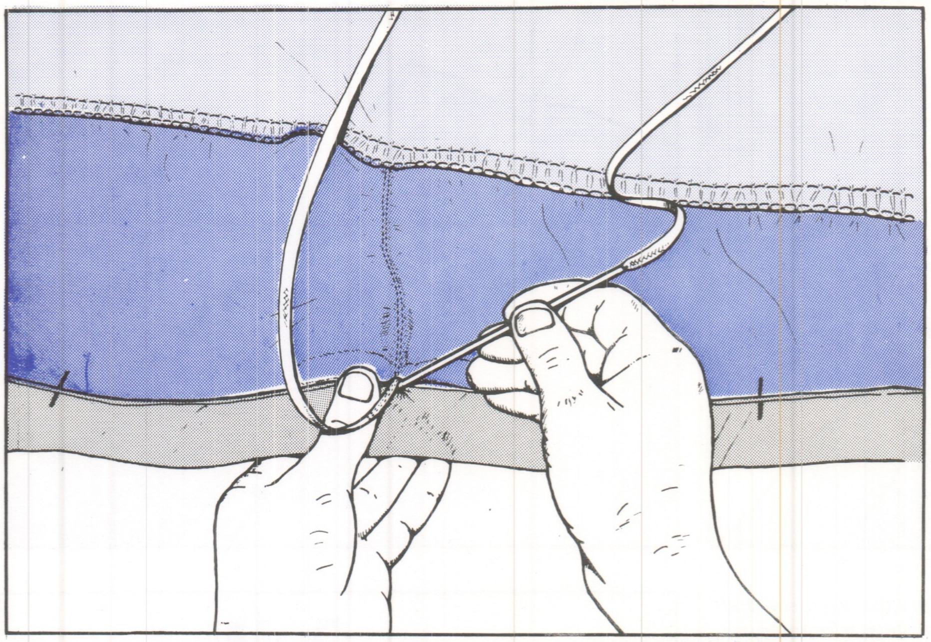




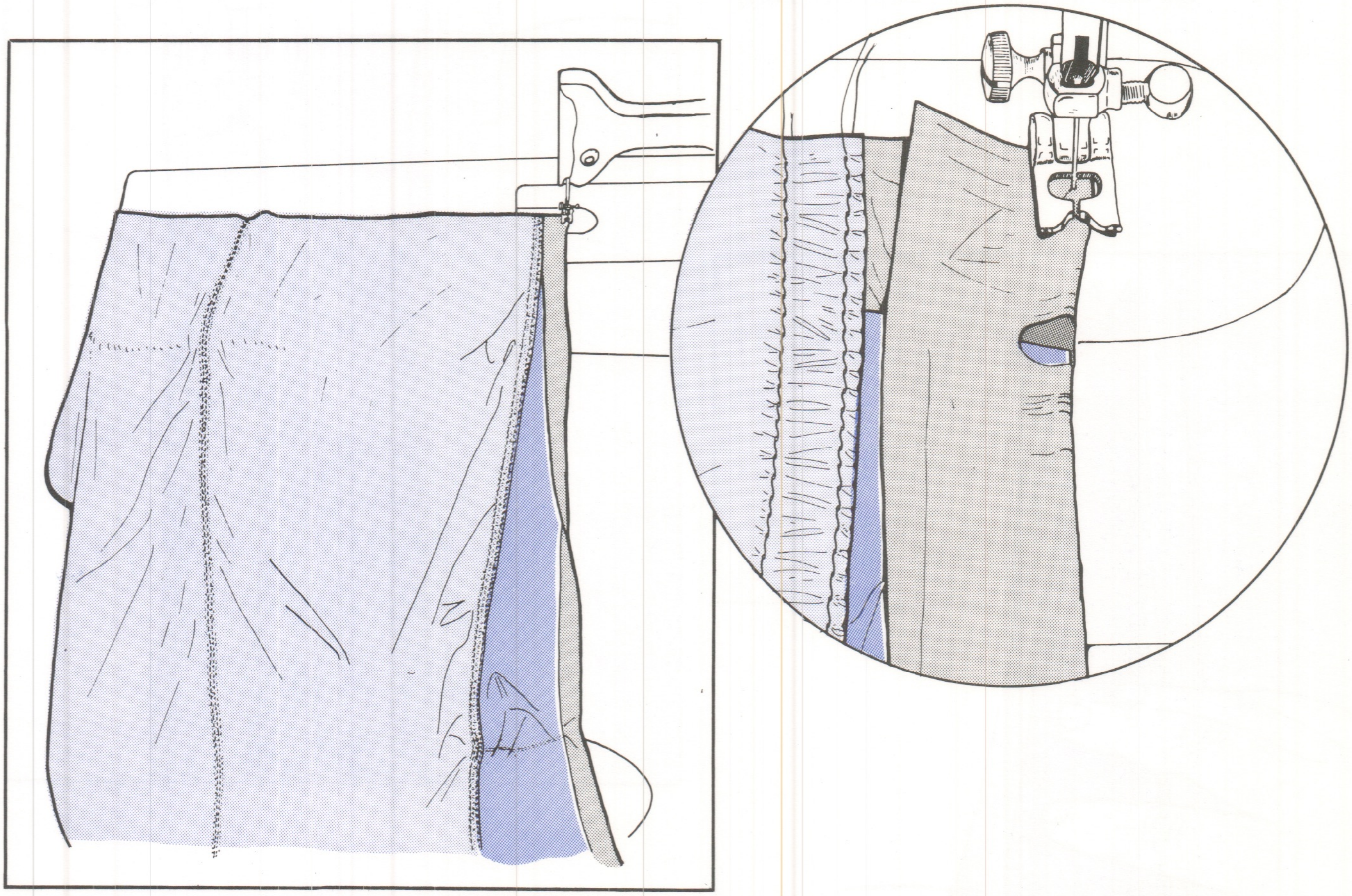
After step 2, the bottom edge of the rib on the guideline. The cross tape of the A line is stretched out tight and flat along the edge.



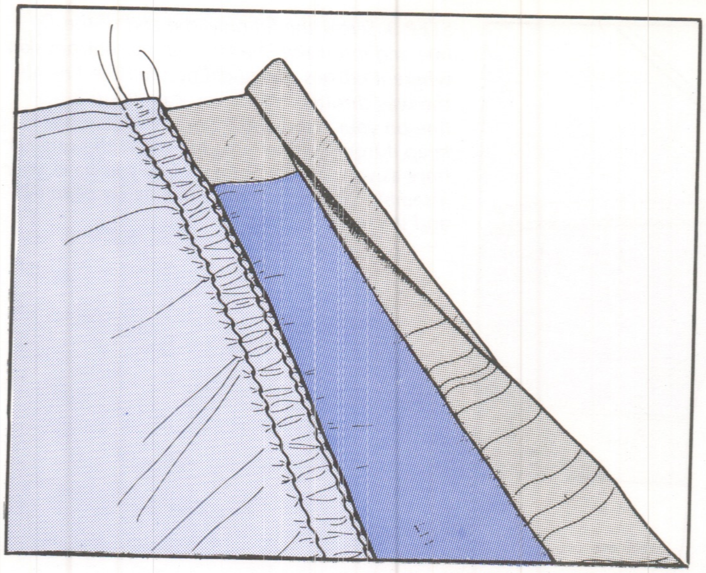
The cross tape of the D line is sandwiched between the skin and rib and the ends are pulled out tight and flat. The B and C lines are done the same.

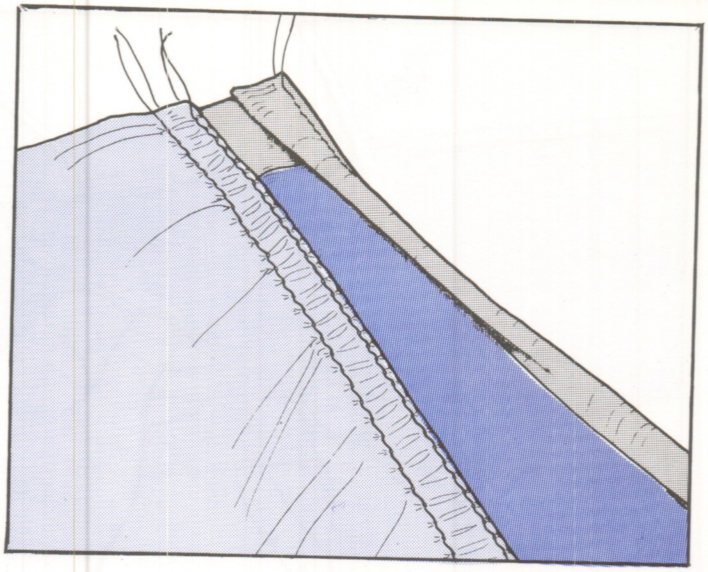


STEP 3 *Screw the fid onto the end of the D line and insert the line through the bottom skin where it crosses the guideline. Pull the line all the way through. (Now you can figure 8 the line on your hand and wrap it with tape to keep it from getting tangled.) Insert the other 3 lines as you did the D line. Now you have your assembly looking like the drawing on page 62 and it's ready to sew.*

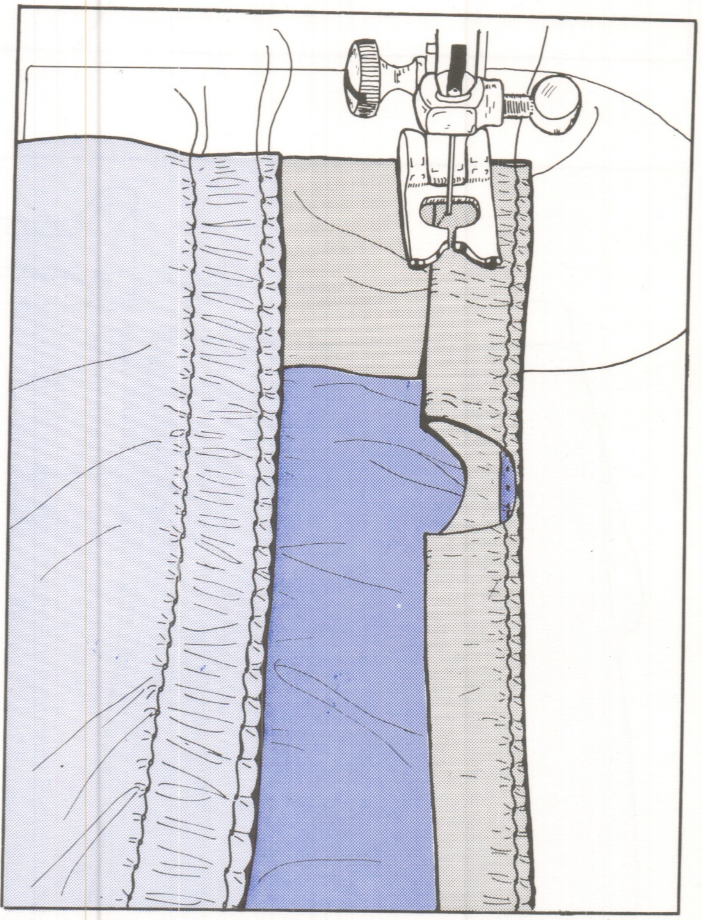


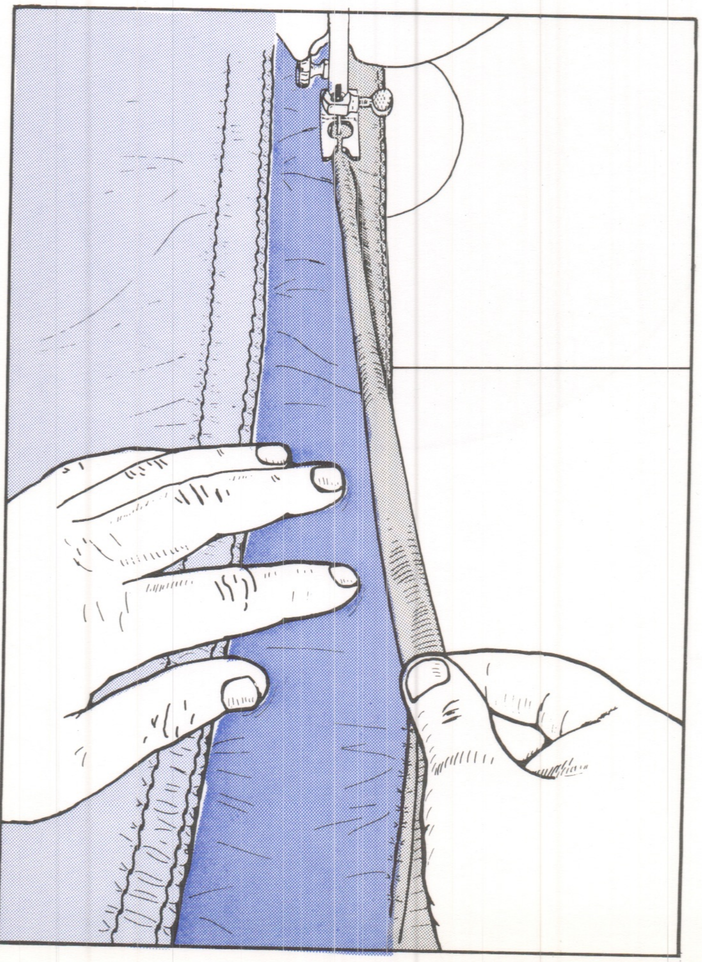
STEP 4 *At the tail, fold the seam allowance back over and position the assembly under the needle as you see right and above. This is the first stitch row of the bottom load seam. Sew a row of stitching from tail to nose about 1/8 inch in from the edge. The sample labeled 'bottom load seam' is like this seam except it has an extra piece of fabric in the seam. When you come to a suspension line, sew over it like you did on the top seam.*



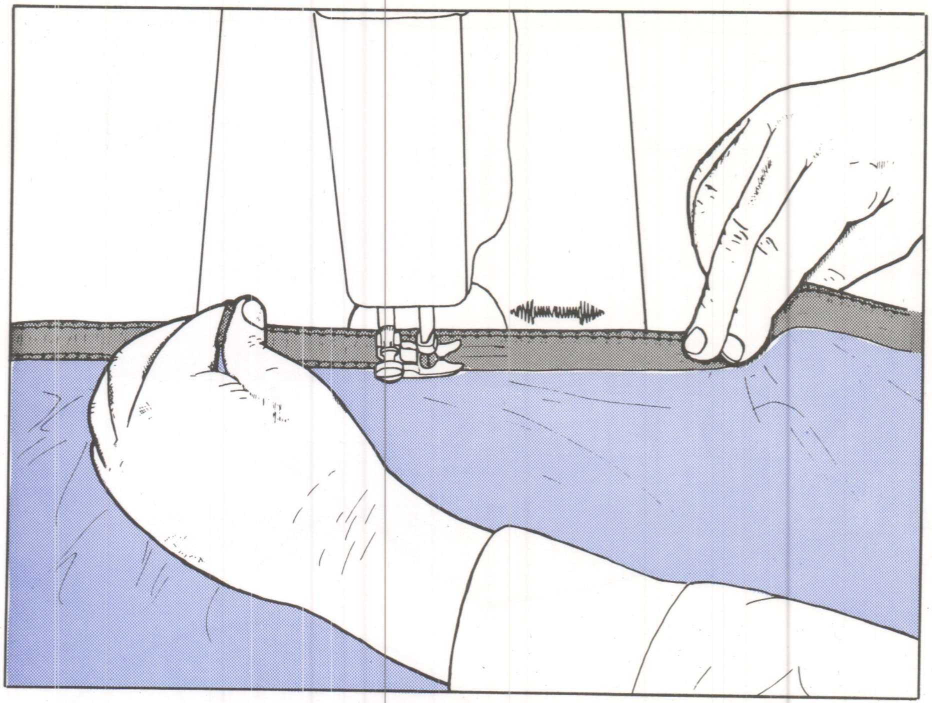


STEP 5 Back at the tail, roll the free edge down to the stitch row and fold the seam over against the rib. Start the second stitch row about 1/8 inch in from the edge and sew along this edge to the nose. As you fold and sew, make sure that you keep the free edge against the first stitch row inside, this keeps your seam a constant width.

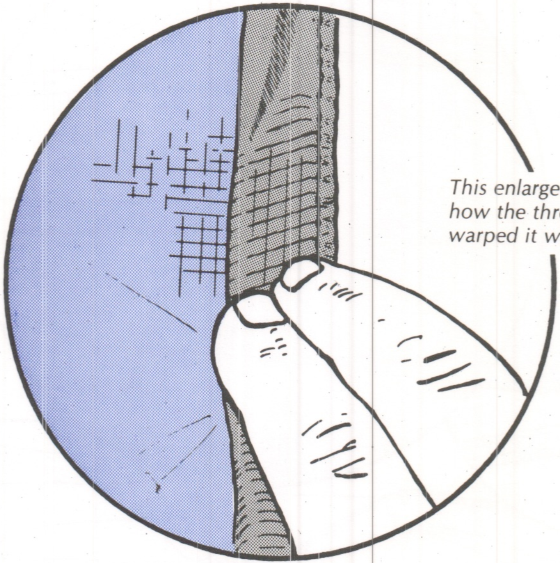




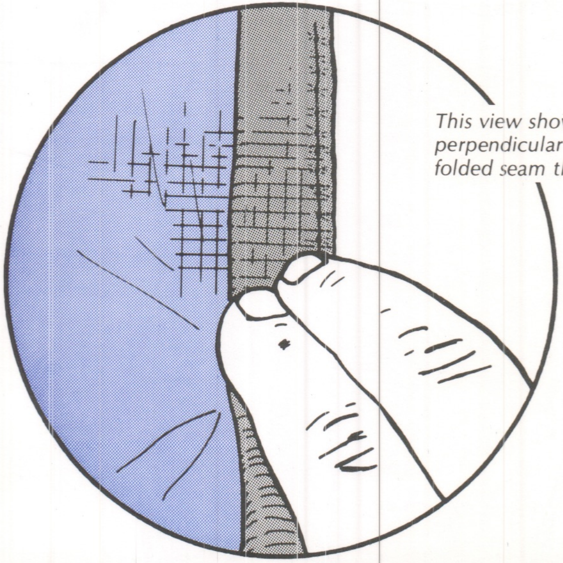
As you are folding the edge under, you'll have a tendency to pull the free edge tight to get it to lay up against the stitch row underneath. This will make a nice looking seam for the first couple of feet and then there'll be so much material out of place that the rest of the seam will be impossible to sew. Using the threads of the fabric as a guide, fold the material straight over, keeping the threads perpendicular to the bottom edge. If you're doing it right, the portion folded over will look puffy and the edge might not stay up under the seam. Push it back under.



With the edge folded under, stretch the entire seam out flat and sew the portion folded. You're having to stretch this seam with more than normal tension because the side already sewn has shrunk a little and you have to pull it back out straight so your second row can go in even. Also, check your top thread tension, it may need to be a little tighter since the extra tension you're putting into the fabric makes it harder for the machine to pull up the top thread.



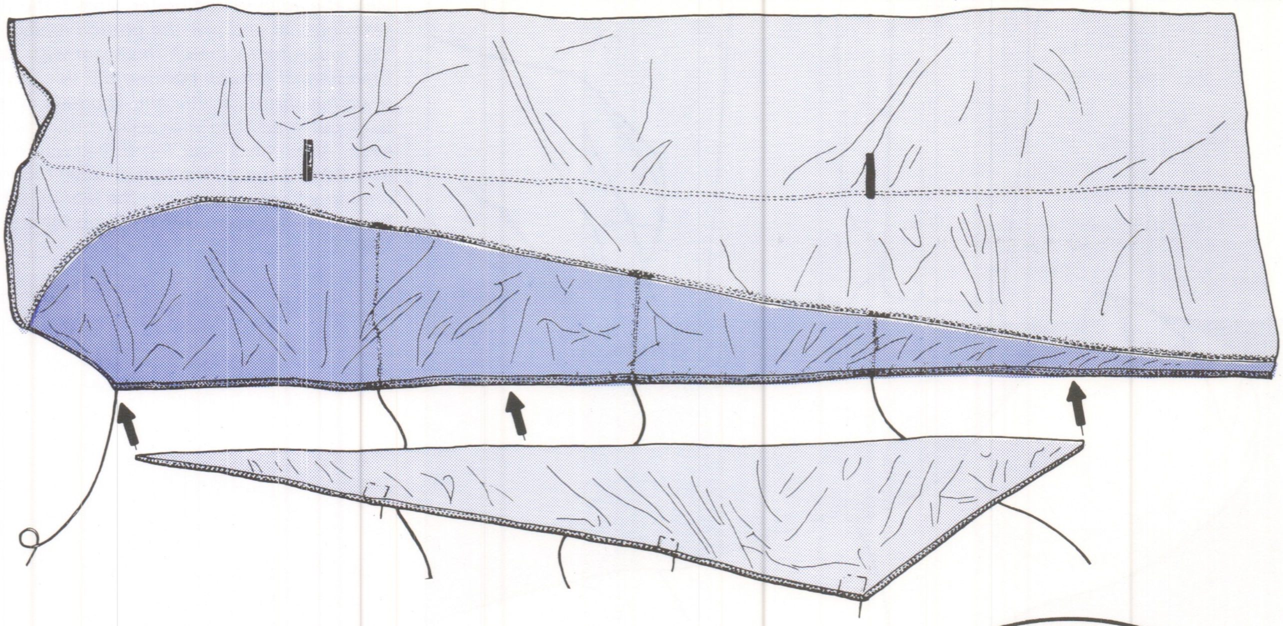
This enlarged view shows improper pulling of the folded material. Note how the thread lines are pulled downward. The seam will soon be so warped it will be unsewable.



This view shows the proper foldover. The thread lines are straight and perpendicular to the bottom edge. This will create a puffy, fullness in the folded seam that will disappear when the seam is tensioned for sewing.

Completion Checkoff

- Loaded rib #1 installed

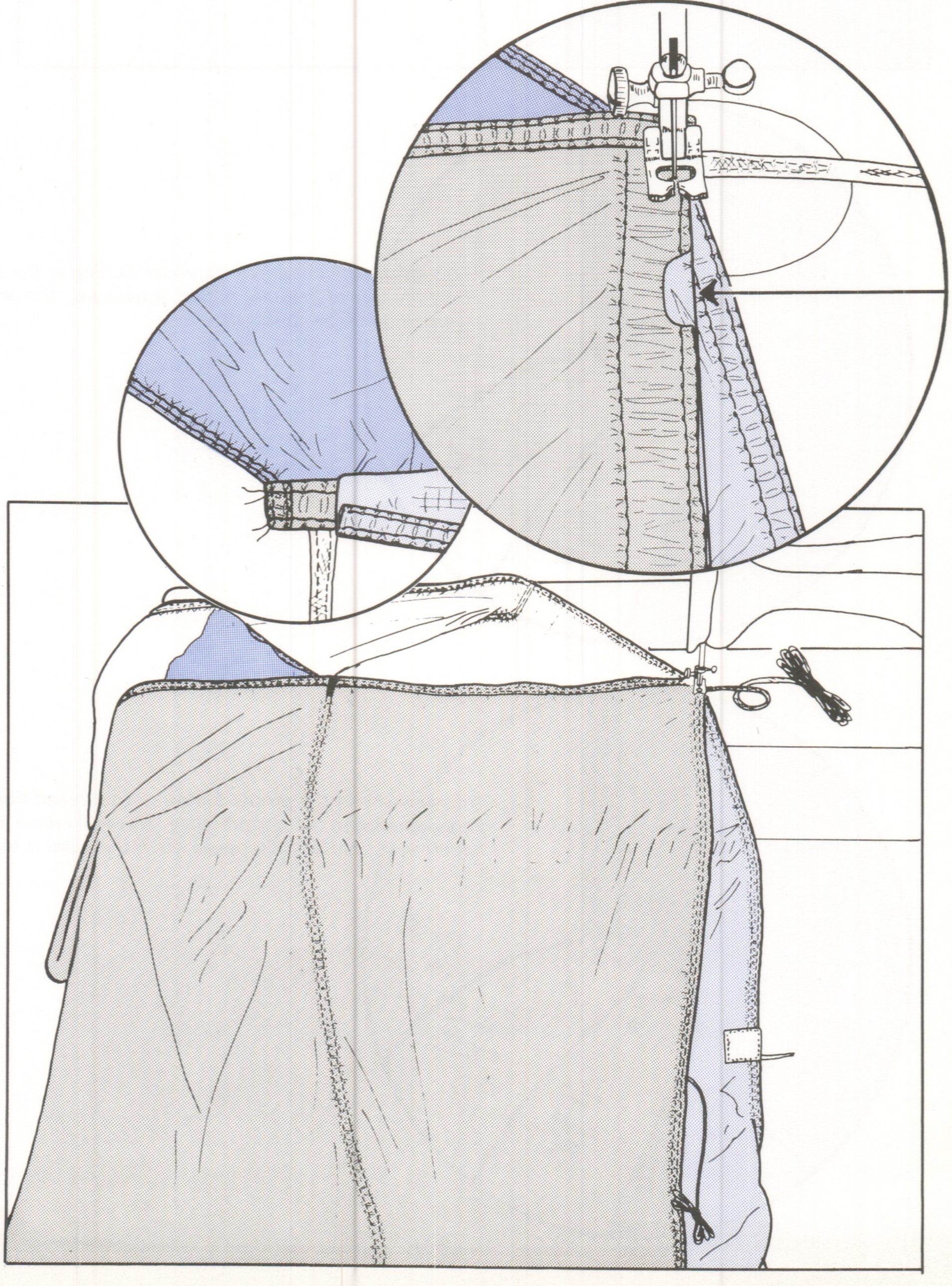


Left Stabilizer Panel

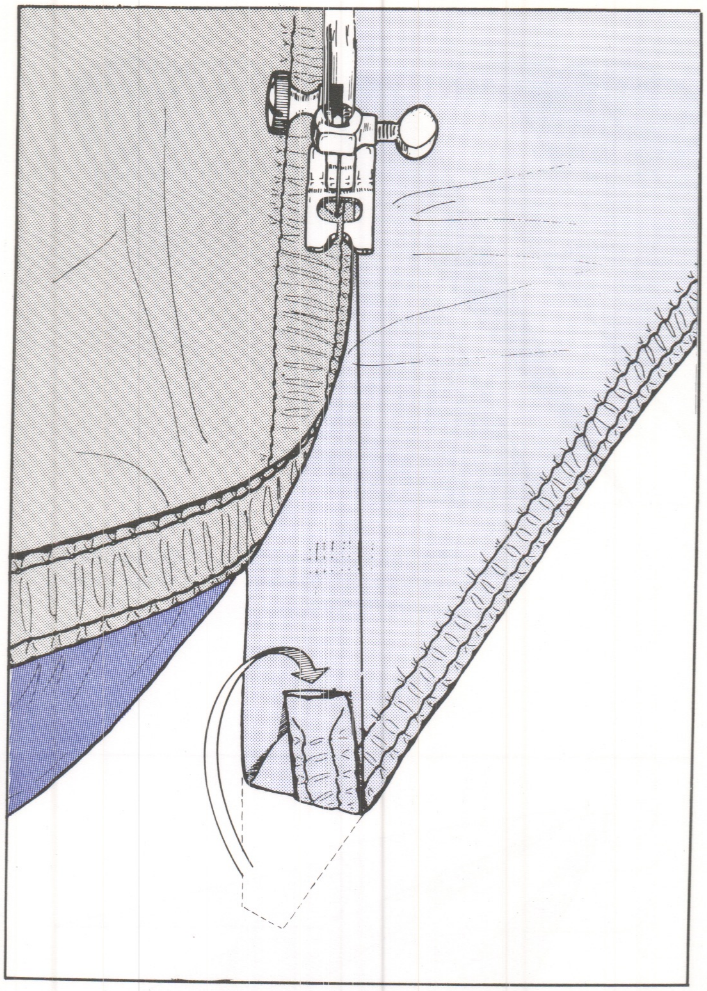
Attaching the left stabilizer panel to the bottom load seam and installing the confluence wraps at the leading edge joints finishes up the left wing tip of your canopy. The stabilizer panels aid lateral stability especially during landing. You'll sew the top edge of the left stabilizer panel onto the outside of the bottom seam starting at the nose with the first pass. You'll start the second pass at the rear corner of the panel and end back up at the nose. The rear corner will get some extra stitching for strength and the front point of the panel will be secured underneath the bottom confluence wrap.

Parts Required:

- cell assembly #1
- left stabilizer panel
- ½" reinforcing tape

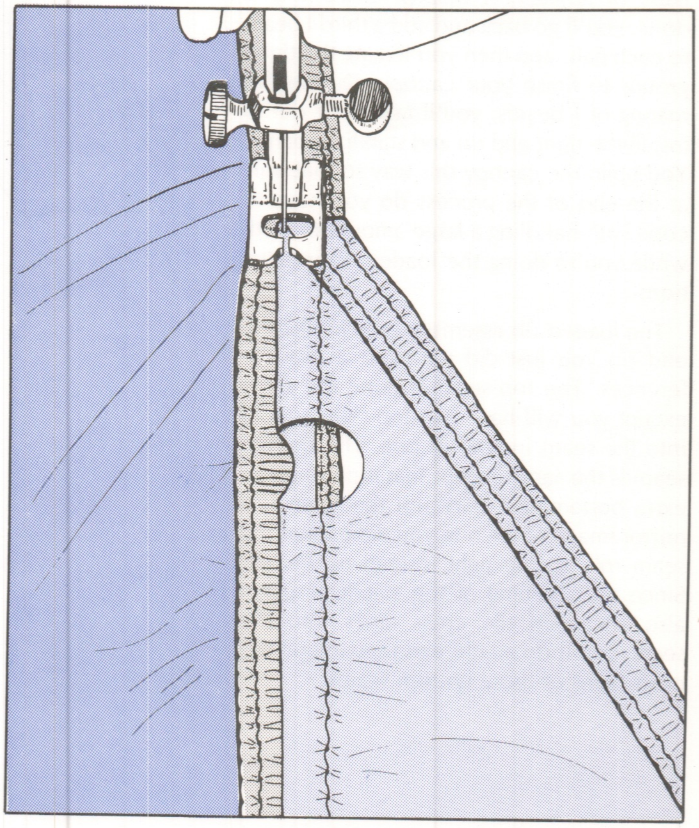


STEP 1 *For the first pass, the bottom seam is sewn onto the stabilizer panel, starting at the nose. Place the panel under the needle and then lay the bottom seam on top of the panel as shown at the right. Align the edge of the seam with the printed line along the panel. Position the tip of the panel just behind the suspension line as shown in the small view of the underside. Sew along the stitch line already there, keeping the edge of the seam lined up on the guideline. Registration of the parts is not critical so there are no registration marks here.*



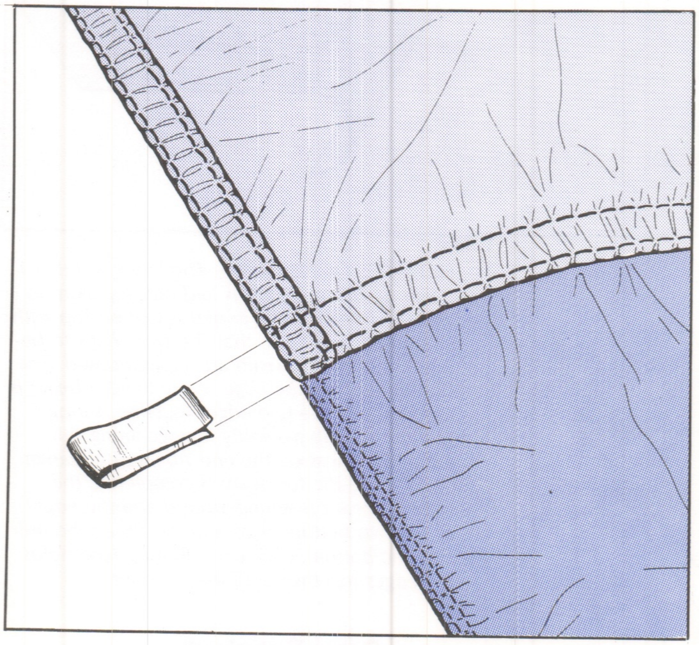
STEP 1 CON'T *When you get near the end of this pass, fold the end of the panel so the short, folded part lies along the guideline and then continue sewing about an inch past the end of the panel. This gives you a finished edge.*

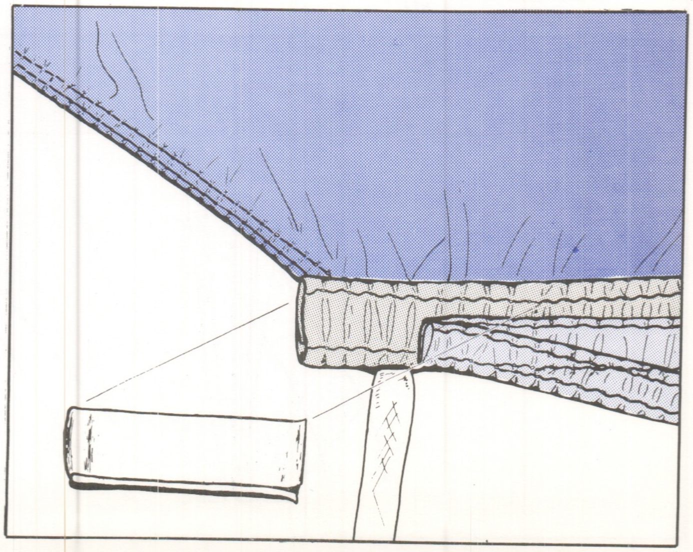
STEP 2 *Turn the work over and start the second pass from the rear corner of the panel. Fold the free edge of the panel under like you did the bottom seam earlier and sew your second pass about 1/8 inch in, along this folded edge. Sew to the end of the panel.*



STEP 3 *Sew a tacking stitch at the rear corner of the panel as shown in the stitch chart.*

STEP 4 *Install confluence wraps at the bottom and top leading edge joints. The reinforcement tape used for these wraps is wider (½″) than that used for the unloaded ribs (3/8″). Refer to the stitch chart.*





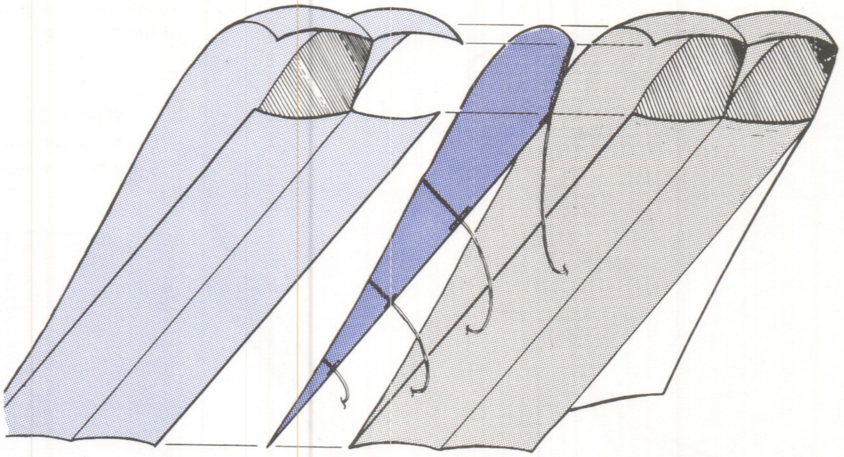
Completion Checkoff

- left stabilizer panel installed

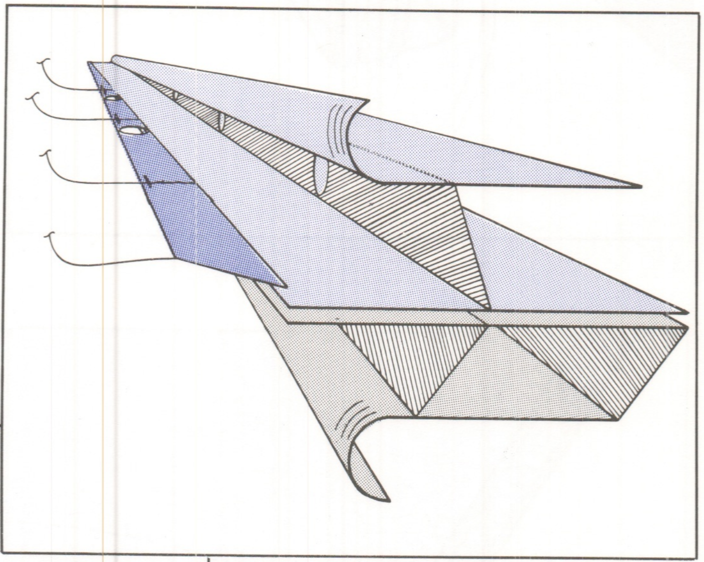
Loaded Rib Installation

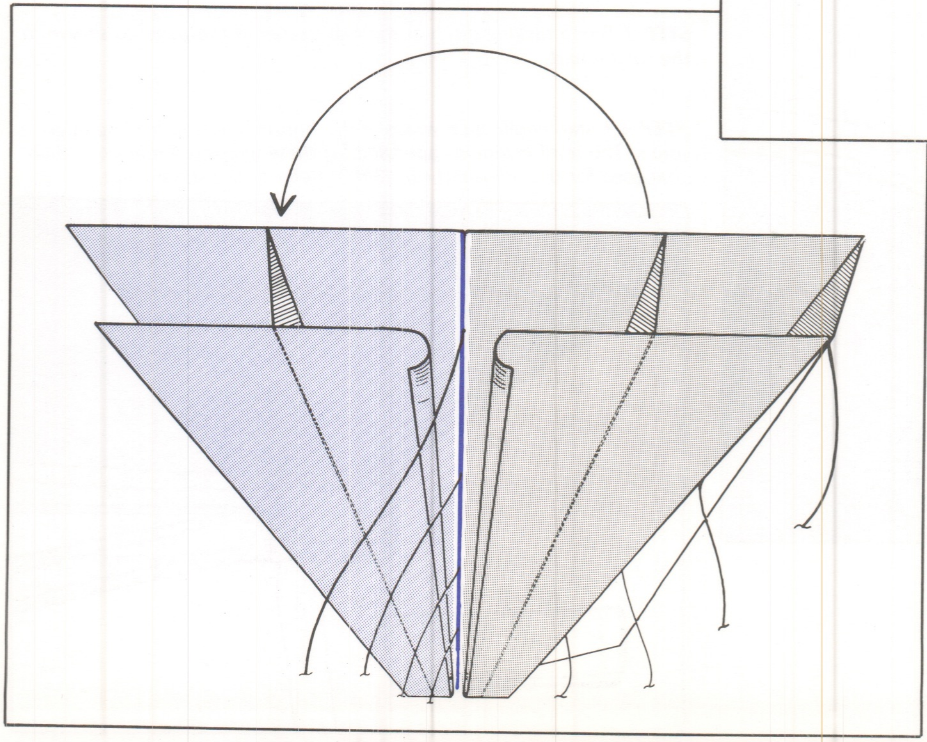
With the installation of a loaded rib assembly, two adjoining I beams are mated and this process is repeated to bring the I beam and loaded rib assemblies into a completed canopy. You start out mating pairs of adjacent I beams. Once this is done, you'll go back and add a third I beam to each pair, and then you'll mate the three groups to finish your canopy. During this mating of I beams, you'll take time out to install the right end rib and stabilizer panel. You build the canopy this way so that only at the end of the process do you have to cope with handling a large amount of cloth while you're doing the loaded rib installation.

The loaded rib assembly goes in like the end rib you just did with just a few differences. The top seam is done the same except you will have two top skins to fold into the seam instead of one. The bottom seam is the same except that it picks up an extra bottom skin part and the seam is a mirror image of the one you did earlier, the seam rolls to the right instead of the left. Since the stitching of the stabilizer panel also anchored the cross tapes into the seam, you'll do a little extra sewing on the cross tapes of these bottom seams.



The installation of a loaded rib assembly brings two I beams together. This process, repeated, creates the canopy.

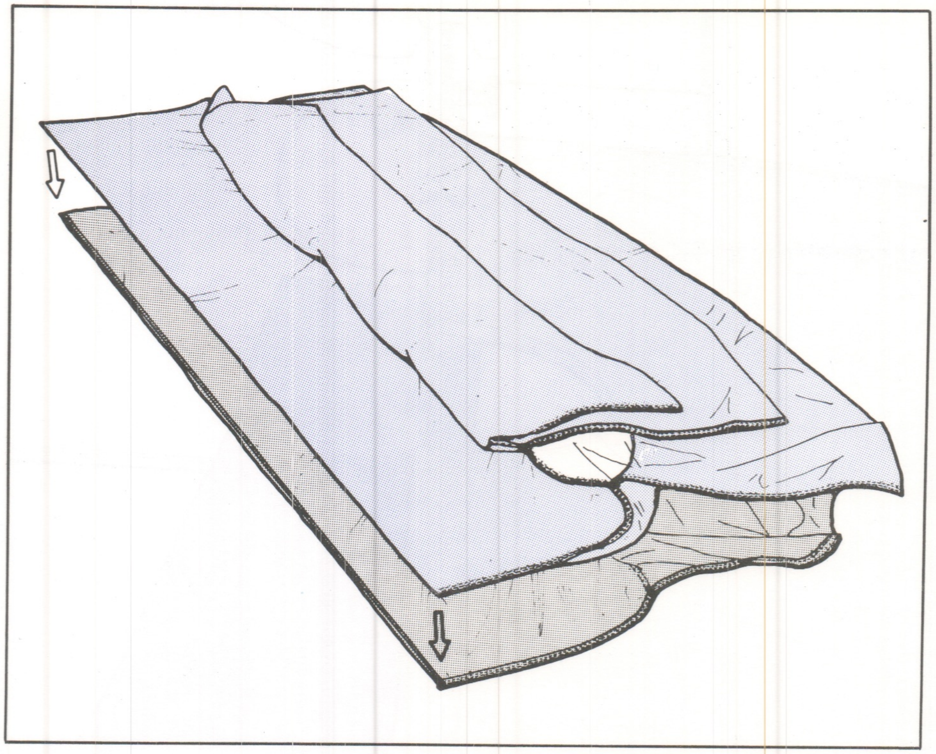


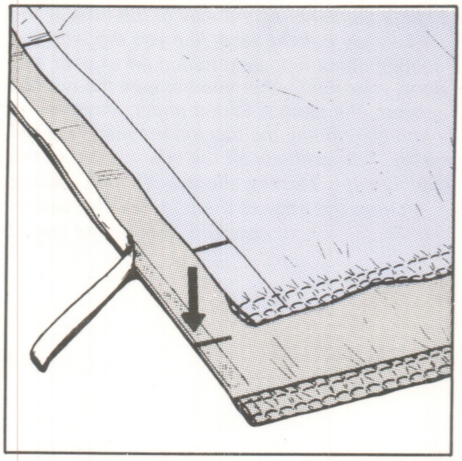


HOW IT'S DONE (above) The lower number I beam (in this case, #1) is laid out, top skin up and the I beam to be joined is laid on top with its bottom side up so that the two edges to be sewn into the top seam are superimposed. The basting tape on the edge of the lower I beam is used to hold the two edges together during sewing. The rib assembly is sewn along this edge like it was on the end rib you did earlier. (left). Once the top seam is completed, the upper I beam is swung around and the edges of the two bottom skins and the rib are bound into the bottom load seam. Basting tape holds the edges together until they're sewn.

Parts Required:

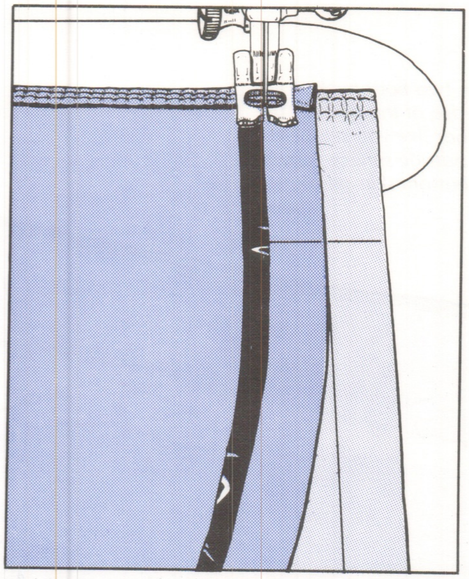
- I beam #2
- I beam #3
- loaded rib assembly #5
- 2-3" lengths ½" reinforcing tape
- fid

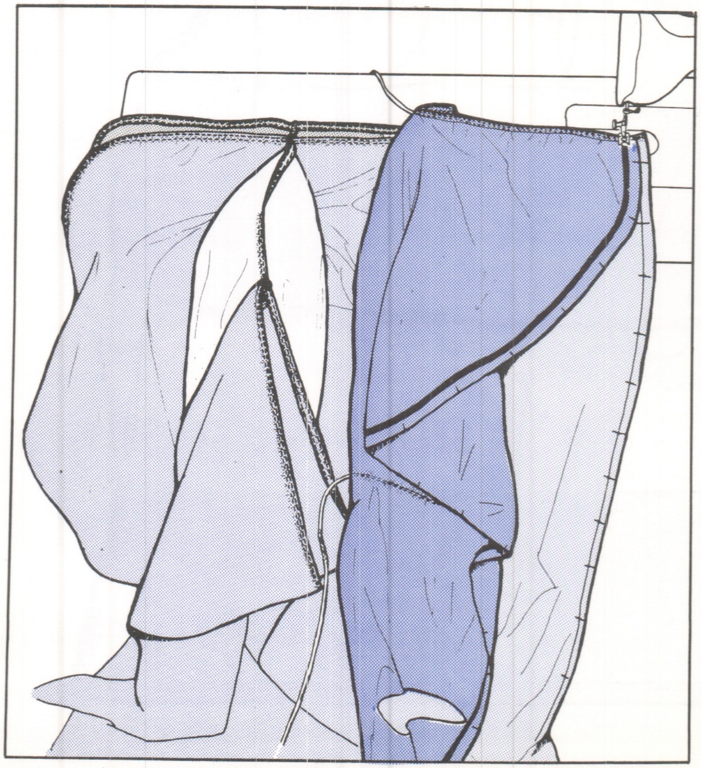


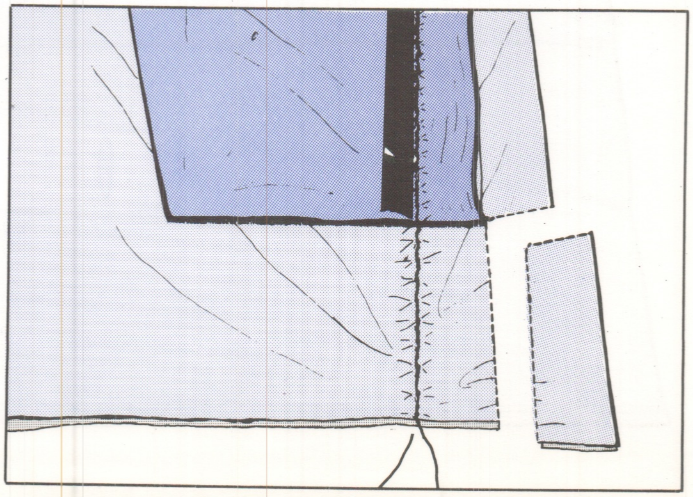


STEP 1 *Position and baste together the edges of the two top skins to be sewn. Lay out cell #1, top skin up with the bottom skin underneath shoved out of the way. Over this, lay cell #2, top skin down. At the front, peel back a bit of the basting paper and press the edges together, aligning exactly the first registration marks. Work your way down the edge, peeling the paper back, little at a time, and basting the edges together all the way to the tail.*

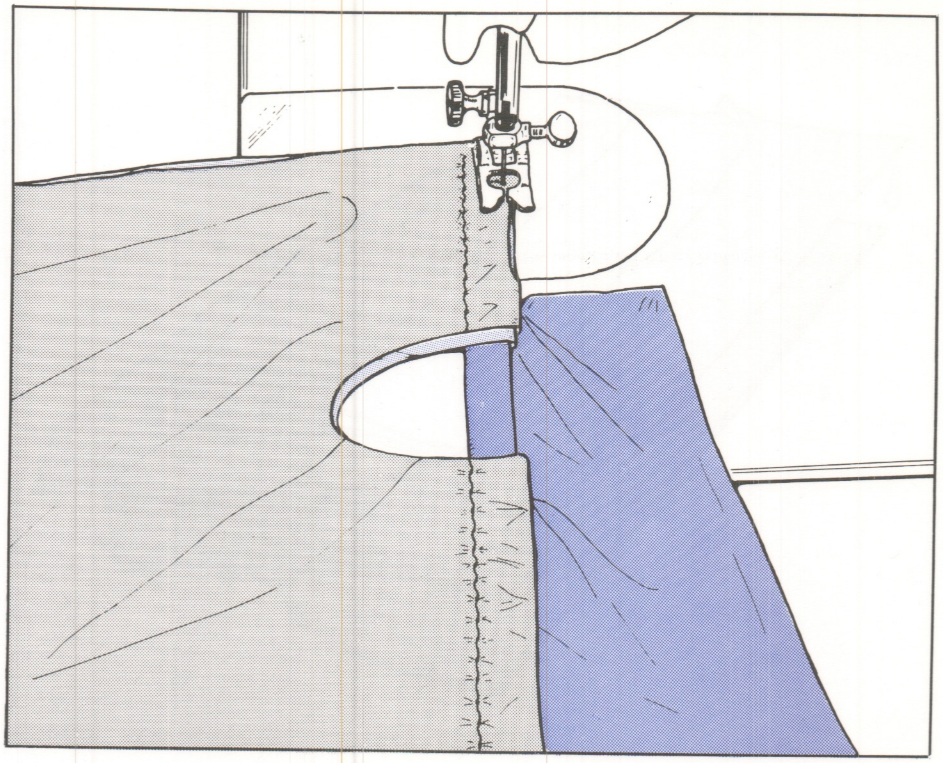
STEP 2 *Position the two cells and the rib assembly under the needle as shown. This is exactly like the top loaded seam you did before except that you're sewing the rib to a pair of top skin edges instead of one. Make sure the first registration marks on the rib and skin line up. Start at the leading edge hem and sew, using the edge of the red tape as a guide, past the end of the rib, to the end of the skins. As you come to the end of the rib there is a short guideline to the end of the piece. If need be, adjust your stitch path so that when you come off the rib, you are on this line. Sew on this line to the edge of the skins. This is important for proper closing of the tail later. After you finish this row, trim out the corner of the skins as shown lower right. Cut up along the rib guideline to the rib and then out to the edge. Remove the stabilizing tape.*



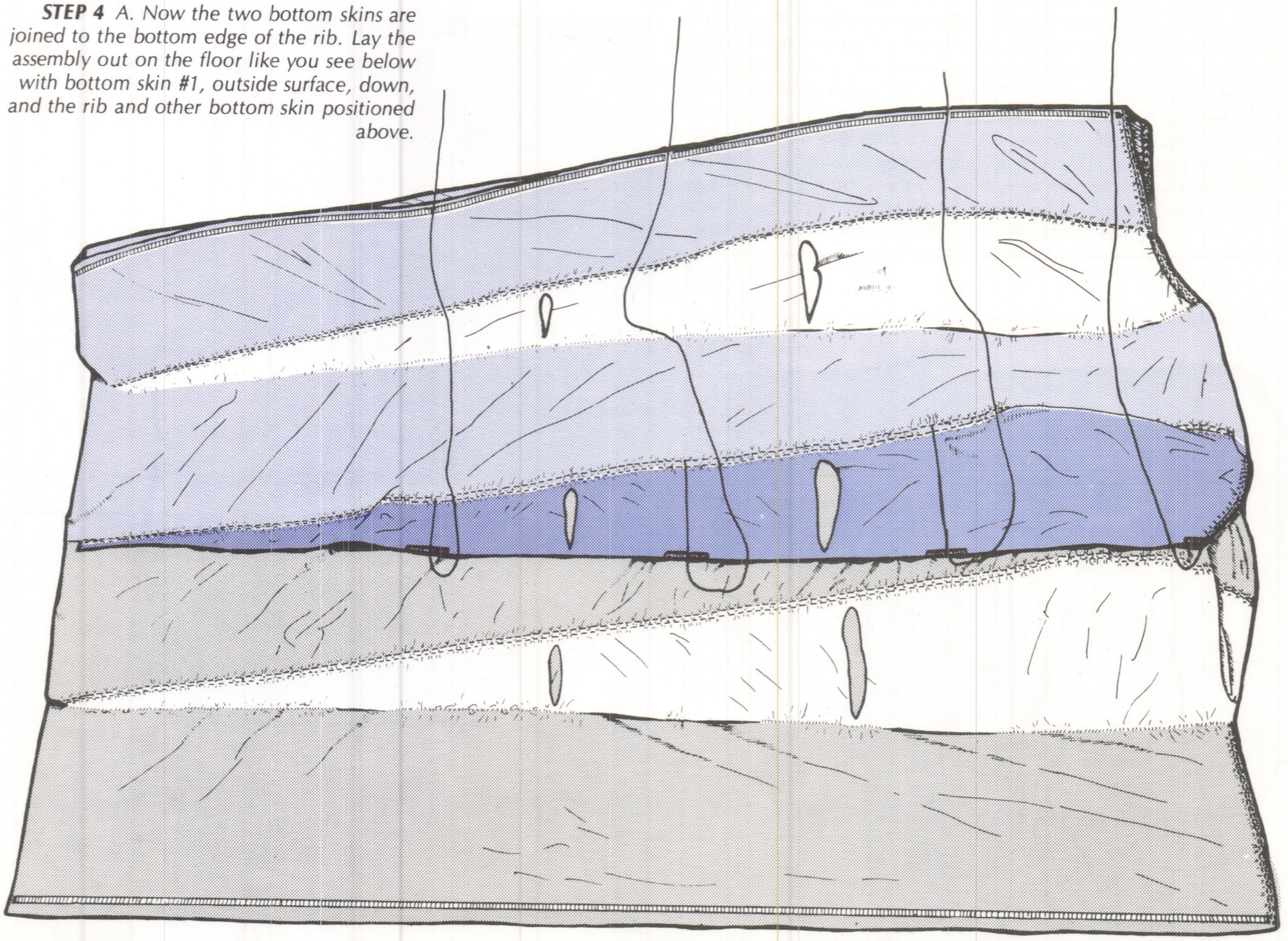


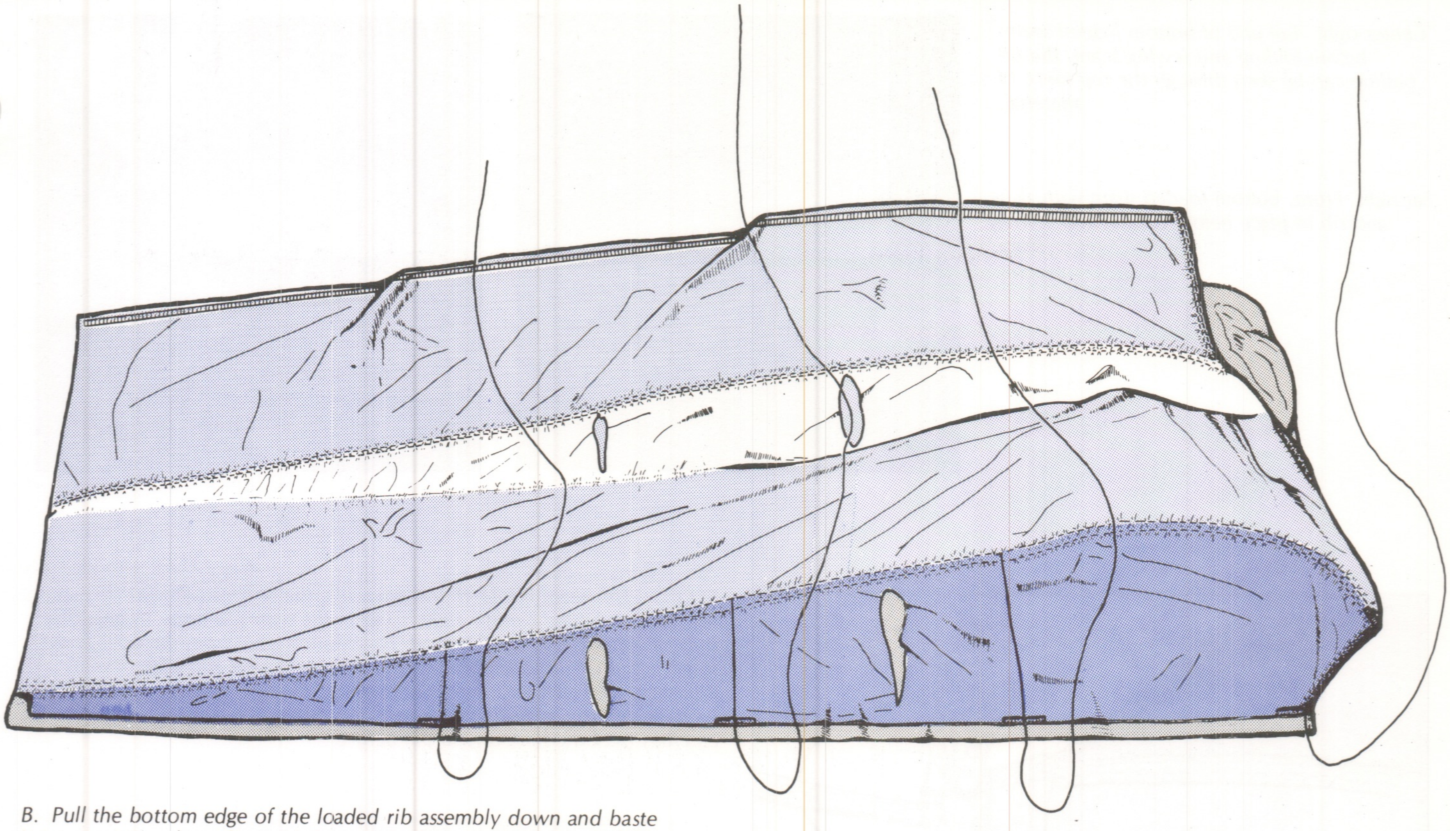


STEP 3 *Start the second row of stitching at the tail. Lay out the work like you did with the loaded rib earlier, skins folded off to your left, rib to your right. After you get past the cut out corner, the seam is folded under, interlocking with the rib like the top loaded seam you did earlier. Fold and sew all the way around to the leading edge, keeping about a 1/8 inch spacing in from the edge of the fold. See the sample marked 'top loaded seam'.*



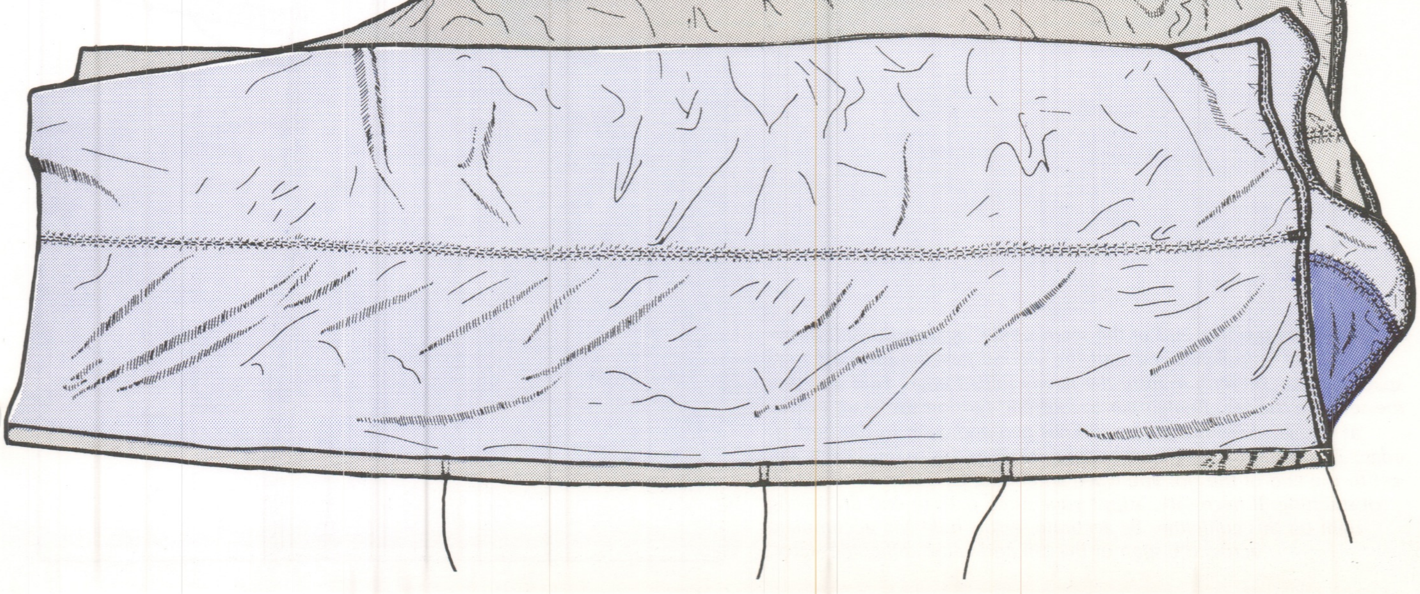
STEP 4 *A. Now the two bottom skins are joined to the bottom edge of the rib. Lay the assembly out on the floor like you see below with bottom skin #1, outside surface, down, and the rib and other bottom skin positioned above.*

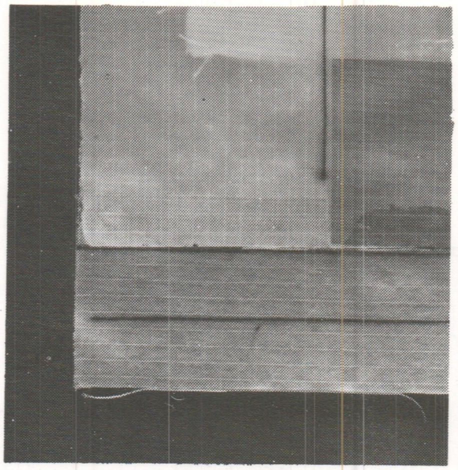




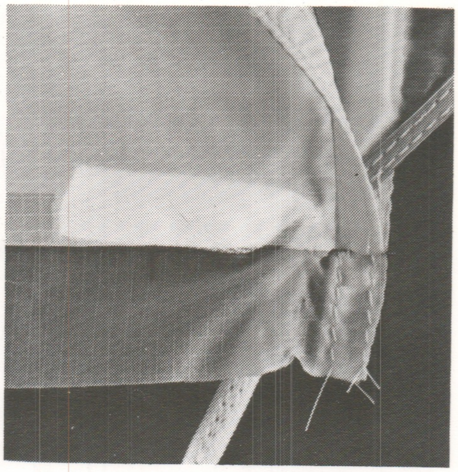
B. Pull the bottom edge of the loaded rib assembly down and baste it into position along the guideline on the bottom skin, start with the first registration mark. This step is like the one you did before except that you're doing it from the other side of the rib. Once you have the basting done, take your fid and insert the suspension lines through the bottom skin as before. Roll them up and tape them.

C. Bring the left edge of bottom skin #2 down and baste it into place. Make sure the cross tapes are flat and tight (a little strip of basting tape on the ends may help). Position the left edge of bottom skin #2 even with the bottom edge of the rib, registration marks aligned. These two edges will be wrapped together in the seam. See the photos on the next page.

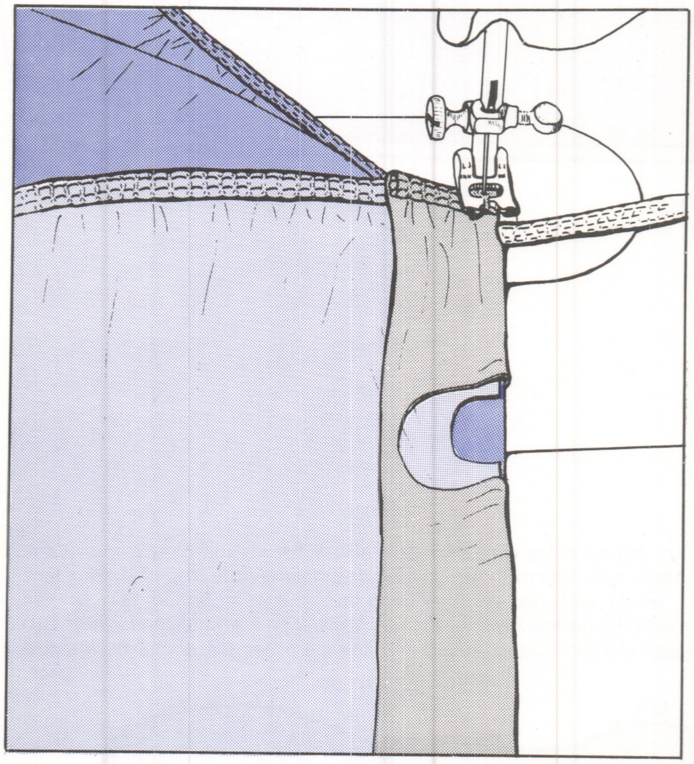




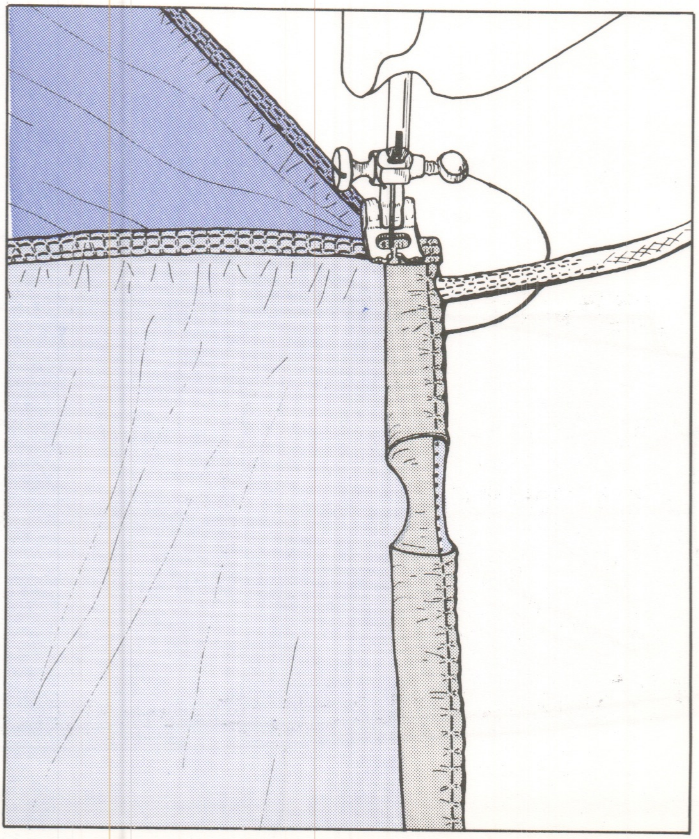
Center right. Tail end of bottom loaded seam, before folding and sewing seam, the rib outline can be seen through the top piece of material.



Far right. Front, bottom loaded seam with skins and rib in place before folding and sewing seam.



STEP 5 This seam is folded and sewn like the one you did earlier except the fabric is folded canopy right, to form the seam. In order to keep the bulk of material to your left, both passes are started from the nose and sewn to the tail. Fold the free end back over the rib and other skin as illustrated and start your first pass in the leading edge hems, about 1/8 inch in from the folded edge. Sew to the other end of the assembly. Sew carefully over the lines as you did before.



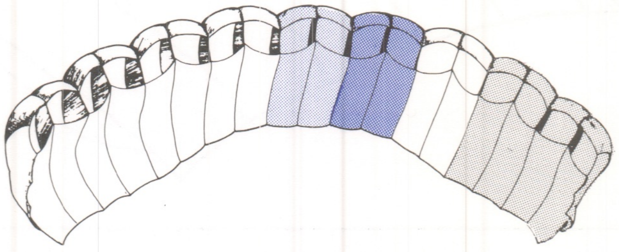
STEP 6 Fold the free end of the seam under, against the stitch row you just completed and start the second pass opposite the first, spaced about 1/8 inch in from the newly folded edge. Fold and sew the seam to the tail. Remember to fold and tension the seam evenly as you go. Keep those thread lines perpendicular to the bottom edge. This is the primary load bearing stitch in this seam. When you get to the end of the rib, you'll see an ending guideline for this row of stitching. If necessary, adjust your stitch path to end up sewing right on this guideline. Be accurate, errors here can accumulate across the span of the tail and cause difficulties later.

STEP 7 *Extra stitching is required to anchor the cross tapes in the seam. Refer to the stitch chart for details and do this final sewing for the B, C, and D cross tapes.*

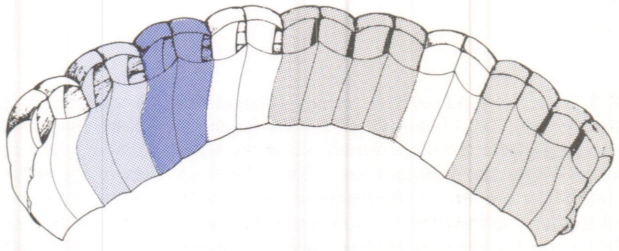
STEP 8 *Install confluence wraps at the top and bottom leading edge joints. (3'' ½ inch wide reinforcement tape)*

In mating the #1 and #2 cells, you have learned a major assembly process. You'll repeat this job several times according to which canopy you are building. Nine cell instructions are on the left, seven cell on the right below. The little canopy drawings help you know where you are, blue indicates work in progress, grey is completed work.

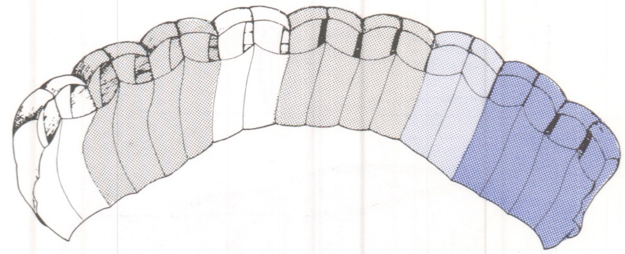
9 cell



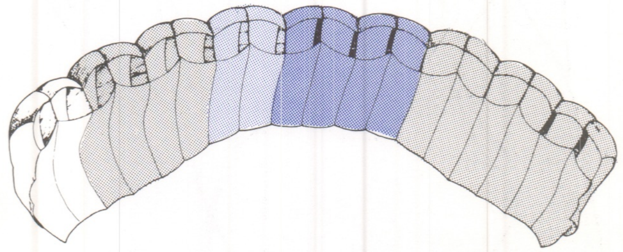
( ) Install Loaded Rib Assembly #9, cells 4 and 5



( ) Install Loaded Rib Assembly #15, cells 7 and 8

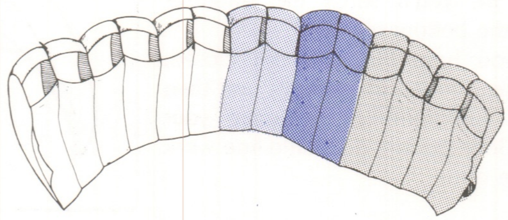


( ) Install Loaded Rib Assembly #5, cells 2 and 3

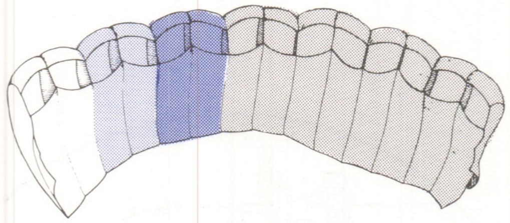


( ) Install Loaded Rib Assembly #11, cells 5 and 6

7 cell



( ) Install Loaded Rib Assembly #7, cells 3 and 4



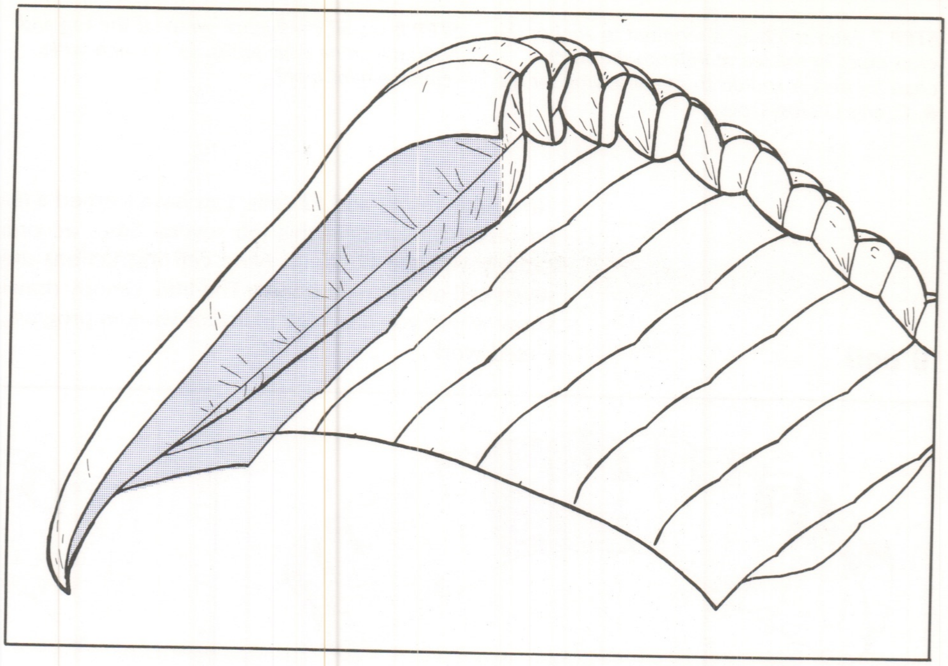
( ) Install Loaded Rib Assembly #11, cells 5 and 6

NOTE: By now, you've done most of the additional work for the 9 cell. With the exception of a little extra line work, both canopies require the same amount of finish work from here on.

Right Wing Tip

Now you'll finish out the right wing tip of your canopy. Loaded rib assembly #19 (#15) is installed on the right side of I beam #9 (7) and then the right stabilizer panel is sewn into position. The assembly is structurally a mirror image of the left side, so, although the principle is the same, you'll have to do a few things differently. Since you're just about an expert now, these instructions cover just the differences and so are fairly brief. After you get the rib assembly in, you'll stitch the stabilizer panel on the bottom seam.

Once you have this end cell closed, you'll mate it to its subassembly and then mate the subassemblies to create your canopy. Close the tail, do a little line work and you're done!

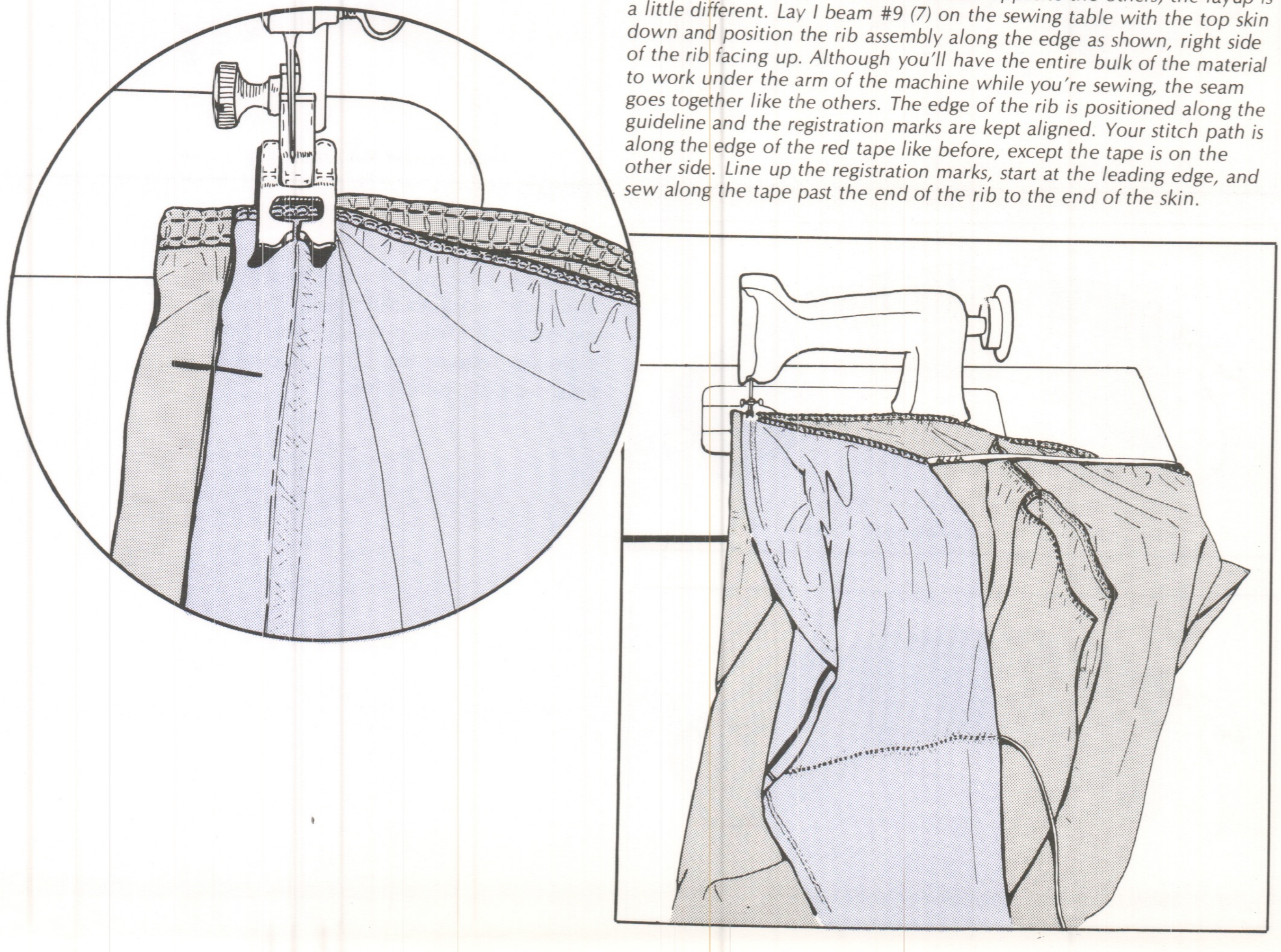


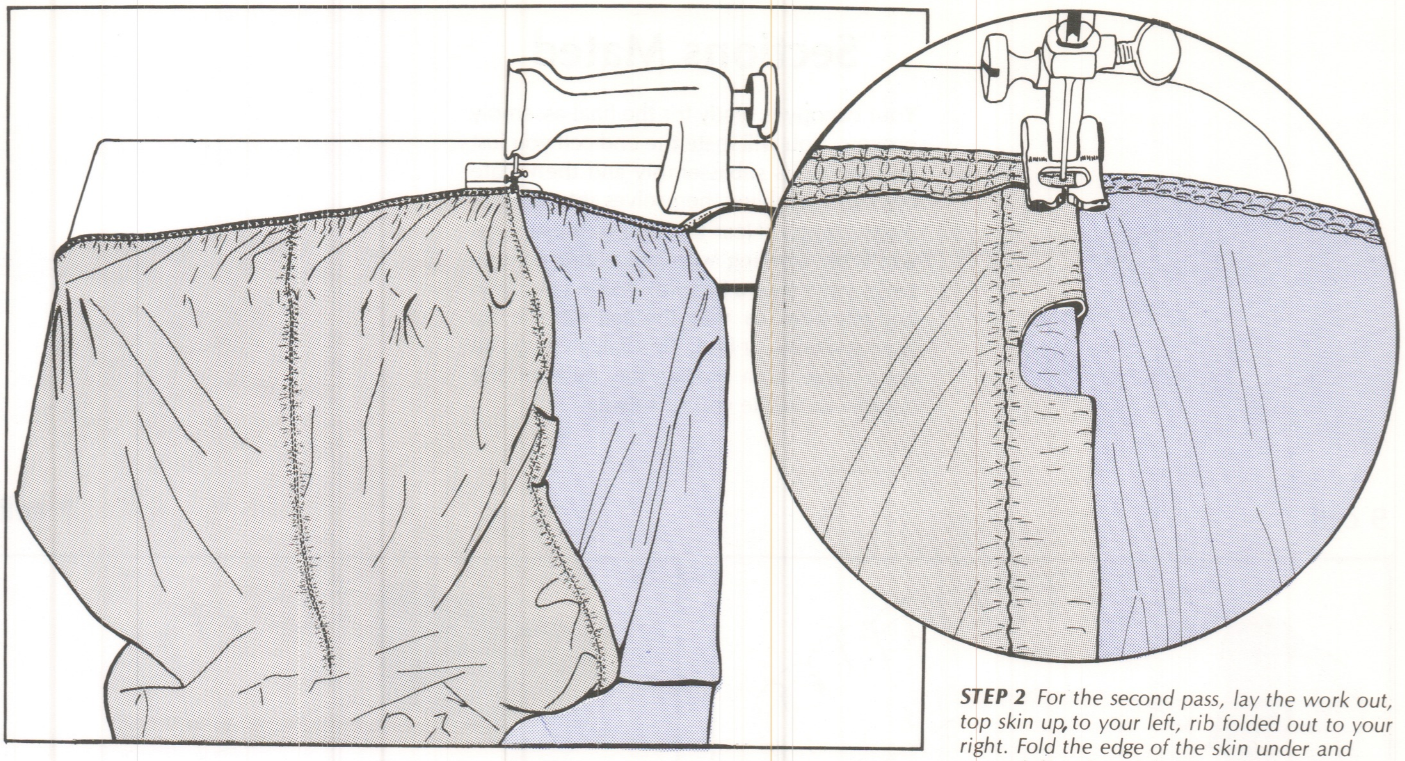
The right end of the canopy is closed by installing an unvented loaded rib assembly on the end cell. Once the rib is in place, the right stabilizer panel is sewn into position on the bottom loaded seam.

Parts Required:

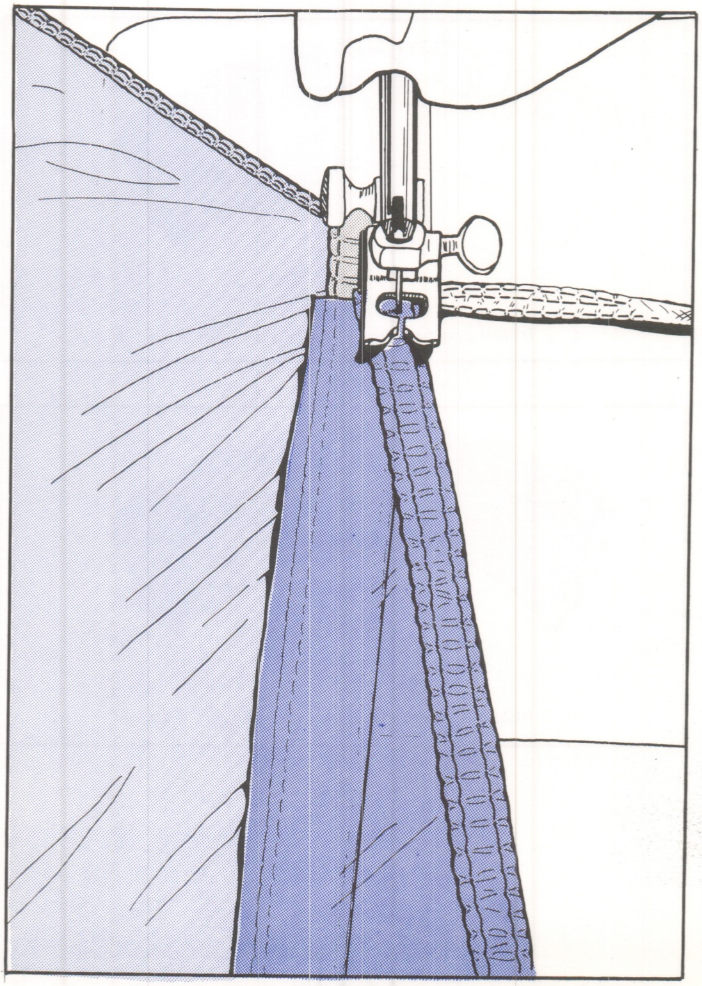
- I beam #9 (7)
- loaded rib assembly #19 (15)
- right stabilizer assembly

STEP 1 *Since the top loaded seam faces opposite the others, the layup is a little different. Lay I beam #9 (7) on the sewing table with the top skin down and position the rib assembly along the edge as shown, right side of the rib facing up. Although you'll have the entire bulk of the material to work under the arm of the machine while you're sewing, the seam goes together like the others. The edge of the rib is positioned along the guideline and the registration marks are kept aligned. Your stitch path is along the edge of the red tape like before, except the tape is on the other side. Line up the registration marks, start at the leading edge, and sew along the tape past the end of the rib to the end of the skin.*





STEP 2 *For the second pass, lay the work out, top skin up, to your left, rib folded out to your right. Fold the edge of the skin under and around the edge of the rib as you've been doing. Sew your second pass, starting from the leading edge and ending at the end of the skin at the tail.*



STEP 3 *Position the stabilizer panel on the bottom load seam and sew the first pass. To have the bulk of the work to your left, you'll do the job opposite the way you did it on the other side. Here, you start at the nose with the seam under the panel, sewing through the panel into the seam below. The final result is the same.*

NOTE: Remember to fold under the rear corner of the panel before you sew past the end.

STEP 4 *Start at the nose again and fold the free edge of the panel under and sew the second pass from nose to tail.*

STEP 5 *Sew the tacking stitch at the rear corner of the panel.*

STEP 6 *Sew confluence wraps around the top and bottom leading edge joints (½ inch reinforcing tape, 3 inches long).*

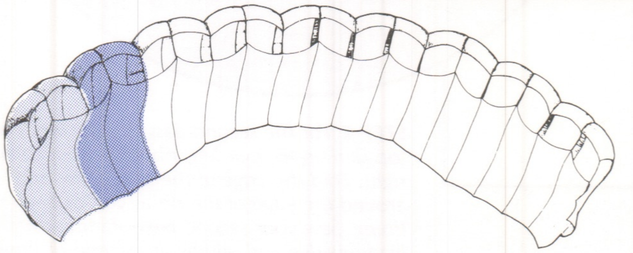
Completion Checkoff

- Right wing tip completed with rib and stabilizer installed.

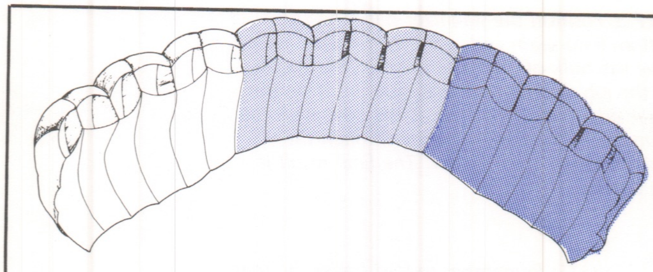
Sections Mated

Your canopy is ready for the final assembly process. You will mate the end cell you just finished to its subassembly and then mate the subassemblies themselves into a complete canopy. Near the end of these steps you'll be working with the entire canopy mass and it'll be a handful. Move your sewing machine so that the left side is up against a table or bed. This will give you an extra large area to lay the bulk of the canopy on while you're sewing.

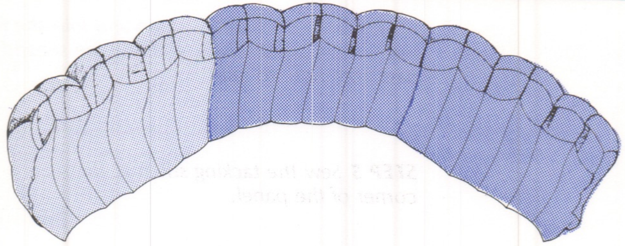
9 cell



( ) Install Loaded Rib Assembly #17 cells 8 and 9

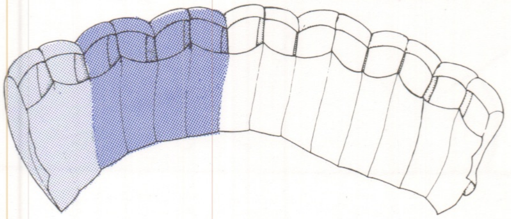


( ) Install Loaded Rib Assembly #7 cells 3 and 4

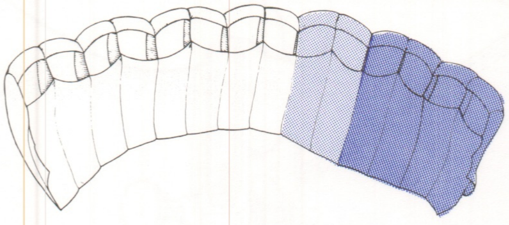


( ) Install Loaded Rib Assembly #13 cells 6 and 7

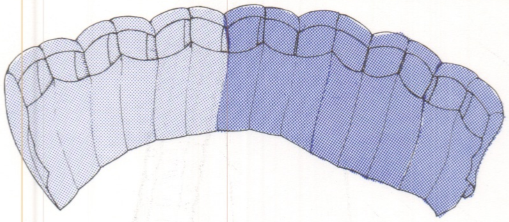
7 cell



( ) Install Loaded Rib Assembly #13 cells 6 and 7



( ) Install Loaded Rib Assembly #5 cells 2 and 3



( ) Install Loaded Rib Assembly #9 cells 4 and 5

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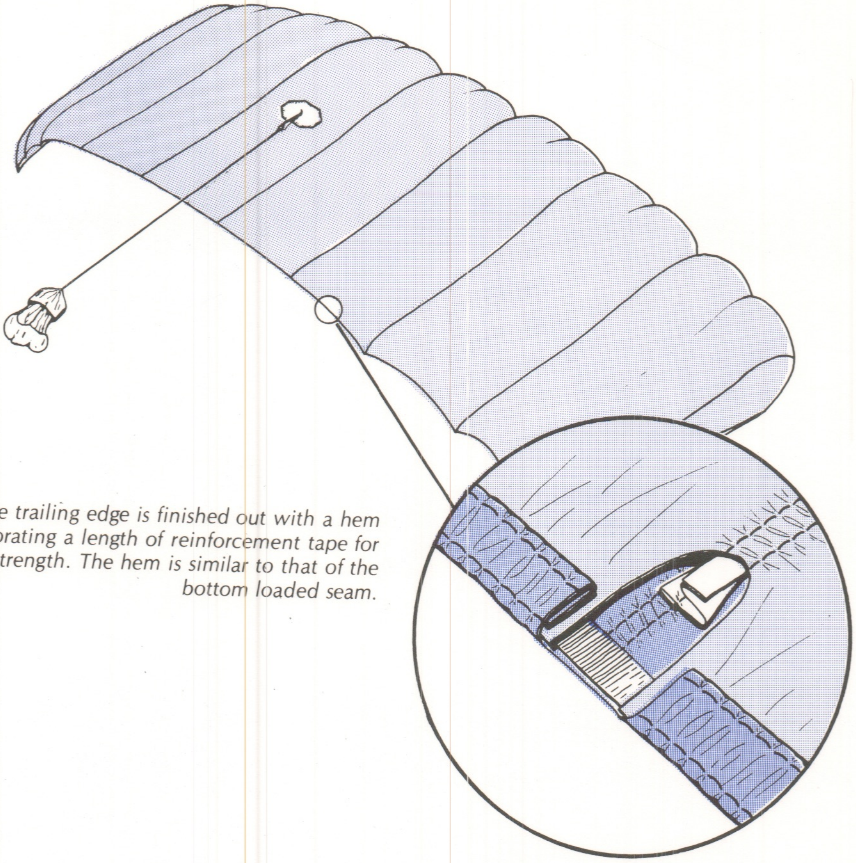
Closing the Tail

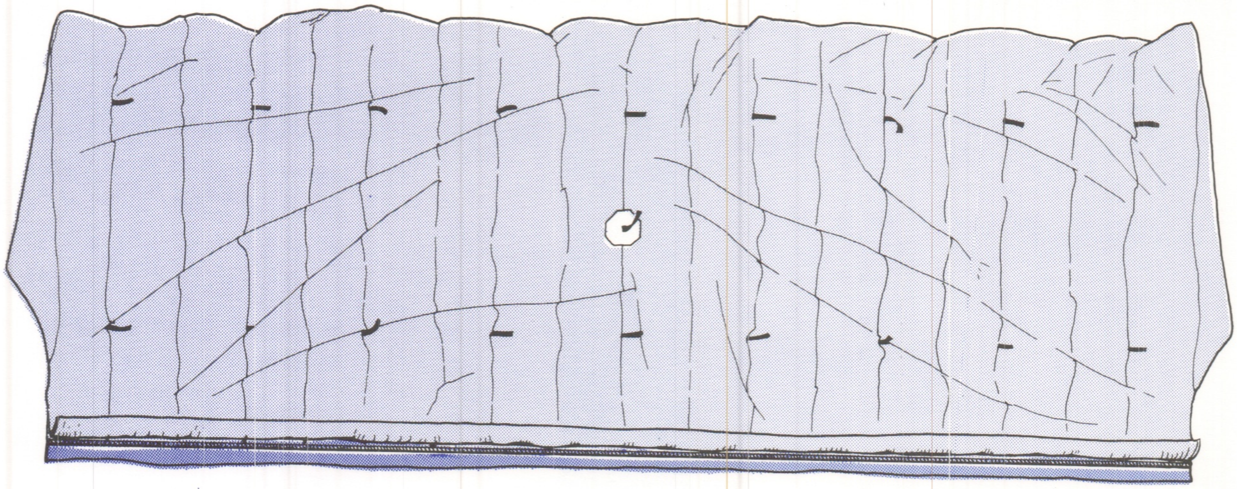
Closing the tail in a trailing edge hem is the last work you'll do on the canopy, the remainder is line work. The hem is designed to absorb routine accumulated tolerances which have crept into the assembly. A spanwise line, marked across the bottom skins, determines the position of the hem and the top unmarked skins are trimmed to this line. This takes care of any difference in the relative fore and aft positions of the two skins.

Since the distance along the trailing edges of the top and bottom surfaces of the canopy is made up of a number of pieces sewn together, it's normal for the two edges not to match up perfectly. The ribs have been cut a little extra tall at the tail end to give some play between the top and bottom skins and the rear corners can be finished out two ways to accommodate this.

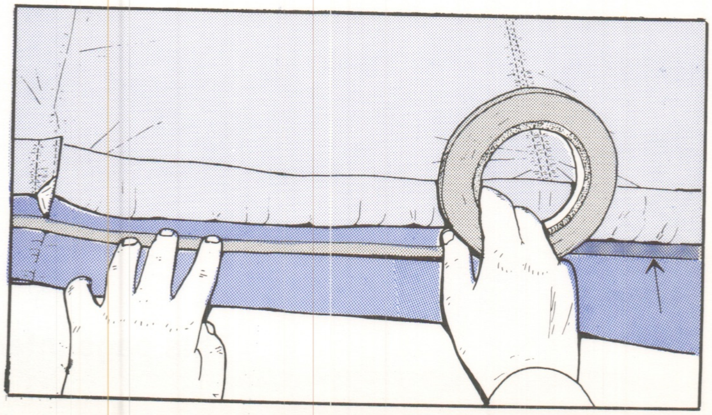
To close the tail, you'll put a strip of reinforcing tape on the bottom skin and stick the top skin to it. To get both tail corners to end up the same, you'll start in the middle and work to the ends. After trimming off the extra material on the top skin, you'll roll and sew the trailing edge hem. The hem is done like the bottom loaded hem.

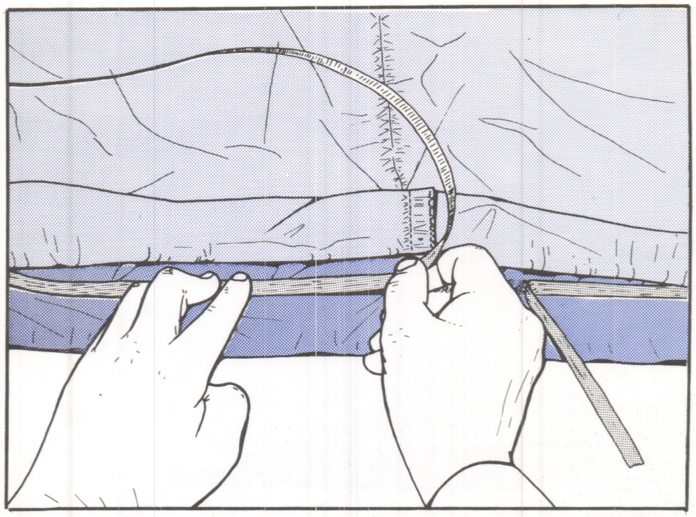


The trailing edge is finished out with a hem incorporating a length of reinforcement tape for extra strength. The hem is similar to that of the bottom loaded seam.



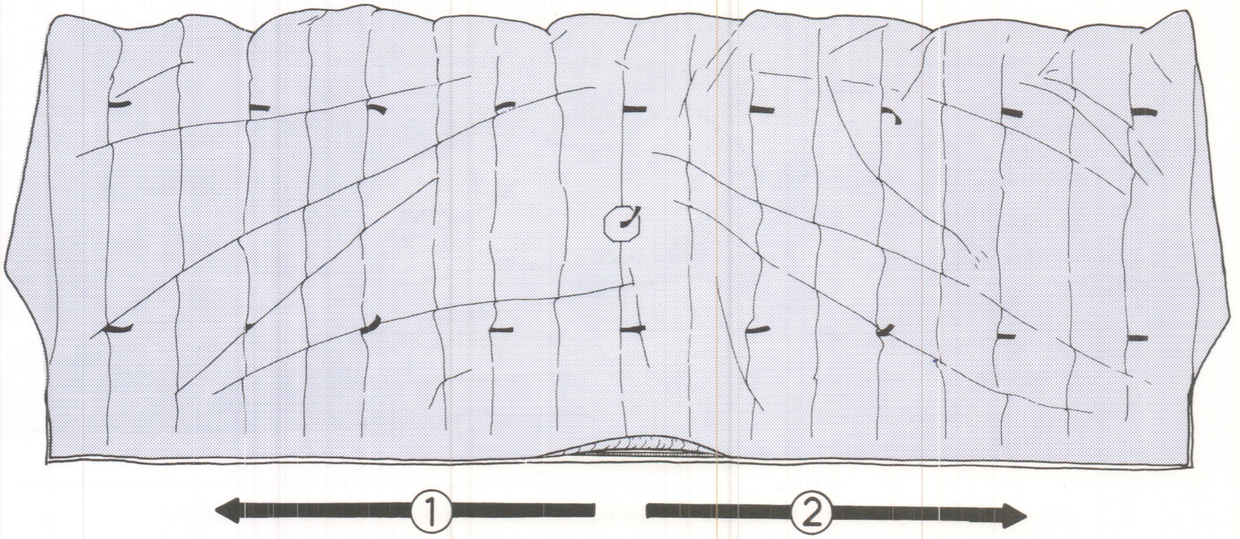
STEP 1 *Apply a strip of basting tape on the inside surface of the bottom skin along the aft side of the spanwise guideline. This strip should be continuous from left to right sides of the canopy.*

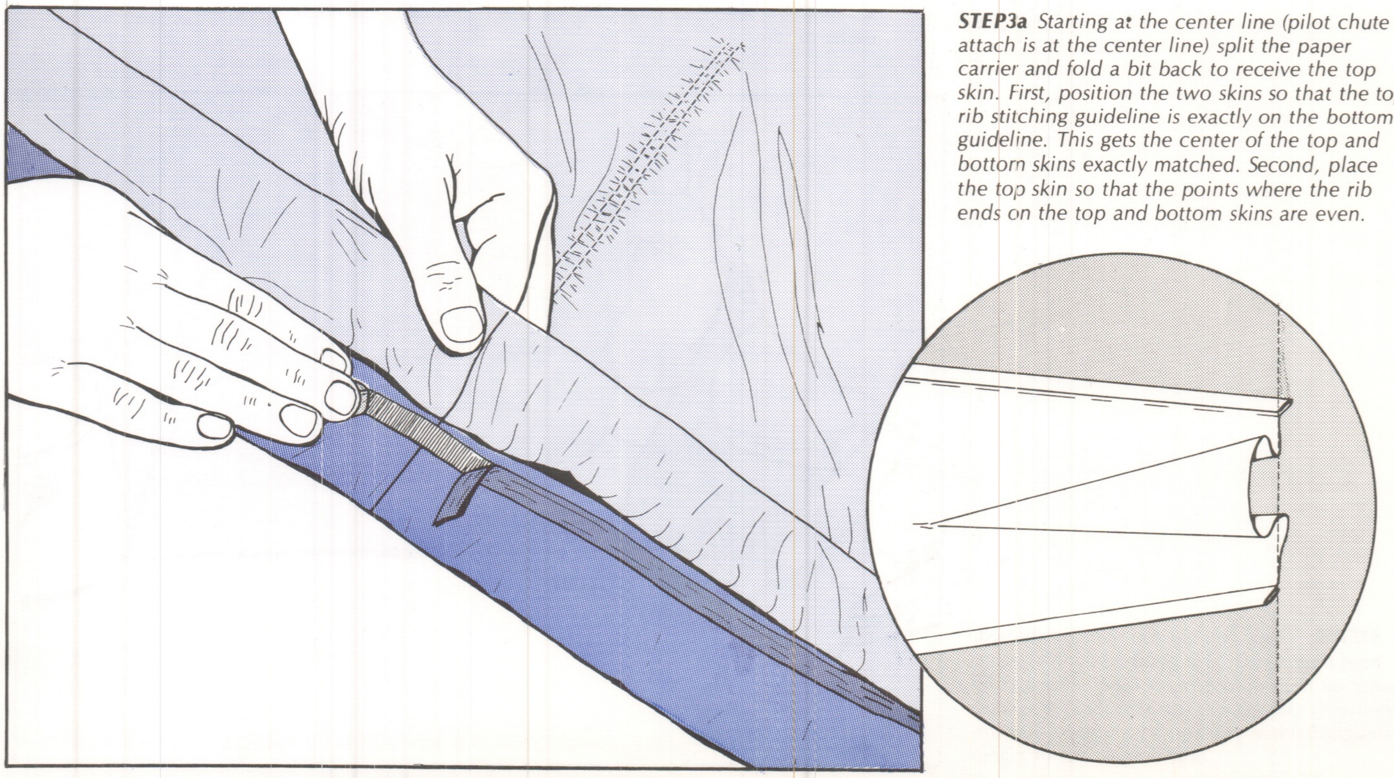




STEP 2 *Remove the paper carrier from the basting tape, section by section and apply a continuous strip of reinforcing tape to the bottom skin, edge to edge. Place the tape so that its adhesive side is to the top.*

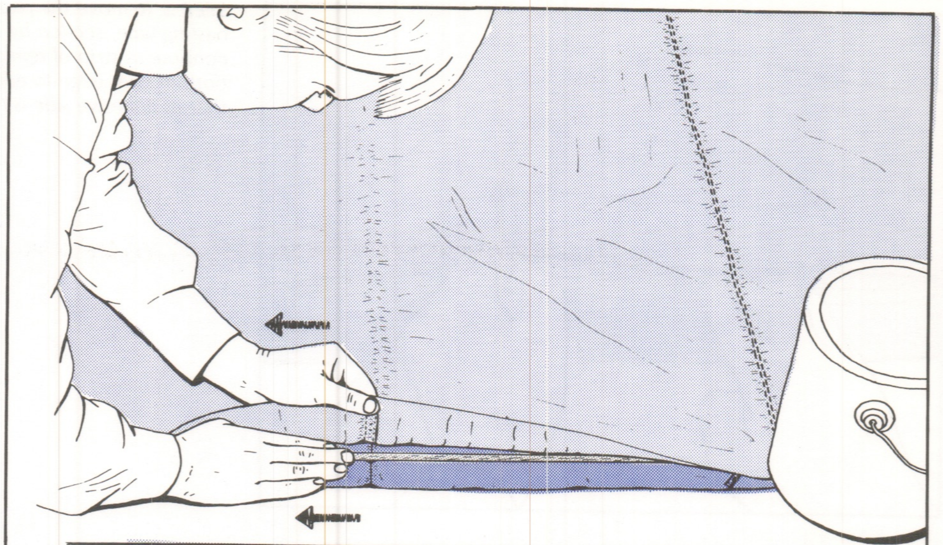
When basting the top and bottom skins together, start at the centerline of the canopy and work toward the sides, first one and then the other. This allows the normal variations which accumulate in the assembly process to be evenly distributed across the tail. Do this work on a clean, smooth floor where you can match up the skins without having to cope with the hassle of a canopy trying to fall off the table. You don't have to be able to lay out the entire canopy, just the part you're working on.

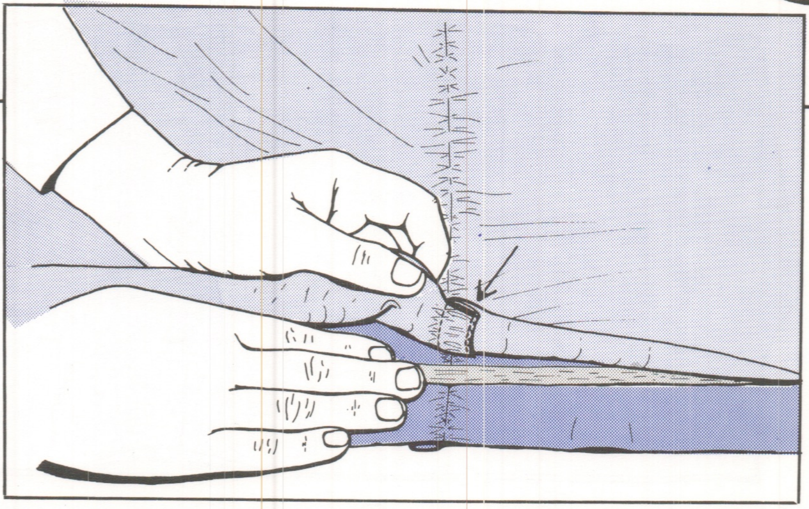




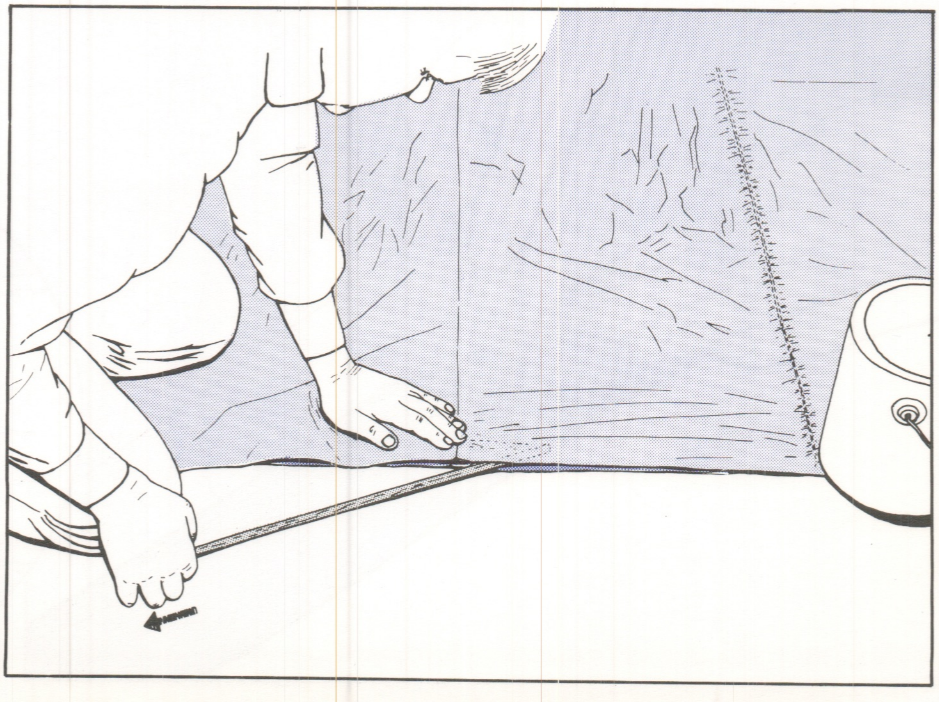
STEP3a *Starting at the center line (pilot chute attach is at the center line) split the paper carrier and fold a bit back to receive the top skin. First, position the two skins so that the top rib stitching guideline is exactly on the bottom guideline. This gets the center of the top and bottom skins exactly matched. Second, place the top skin so that the points where the rib ends on the top and bottom skins are even.*

STEP 3b *Place a weight on the tail and position the skins together. Pull the bottom and top skins out straight and position the top so that the top and bottom end points of the rib are even. As you work your way along, the rib stitching guidelines may get off, indicating that one of the skins is slightly longer across the tail than the other. Don't worry about this unless it's so far off at the end that you can't accommodate the difference at the corner. In that case, you'll have to go back and find the problem. For now, just make sure that the top and bottom skins are going together evenly tensioned with the ends of the ribs straight.*

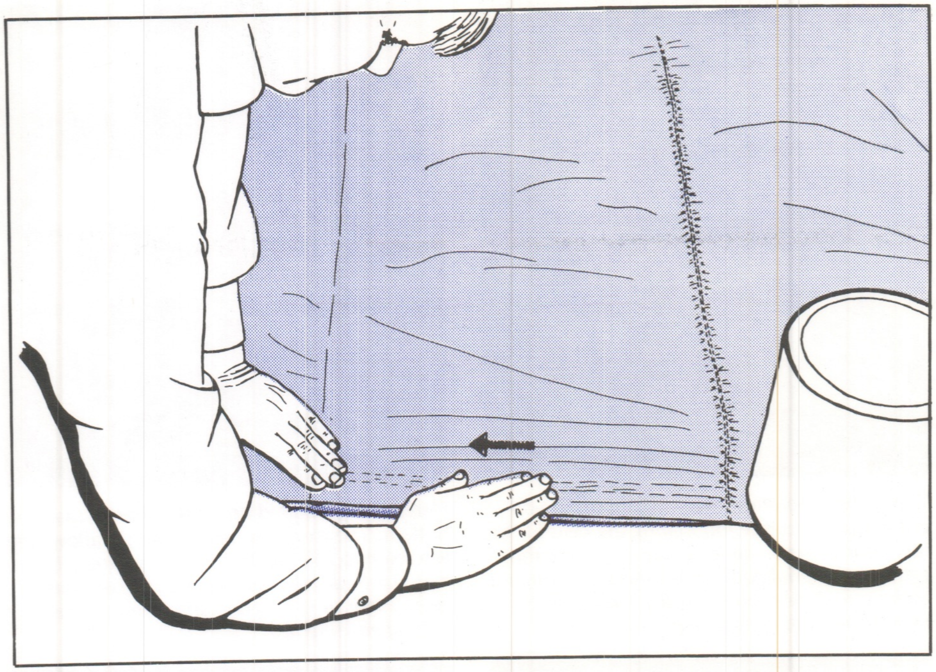




When laying down the top loaded seam, regardless of which half of the canopy you're working on, fold all the seams toward the right side of the canopy. When you sew the tail, you'll fold the bottom seams to the left, thus spreading out this bulky area, making it easier to sew.

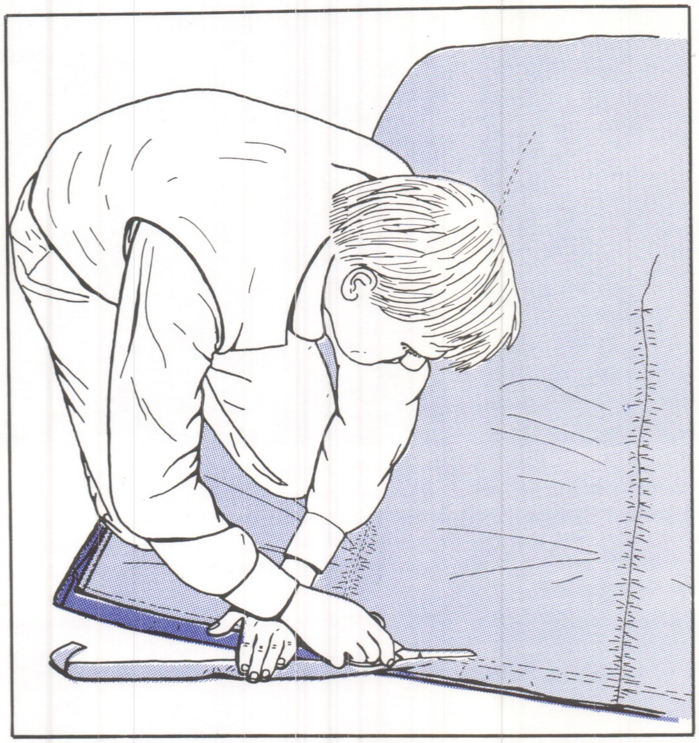


STEP 3c *Once you get the skins positioned, hold them down and gently draw the paper carrier off the reinforcement tape, allowing the adhesive to contact the top skin. Pull the paper as straight back as you can so as not to shift the bottom skin out of place.*

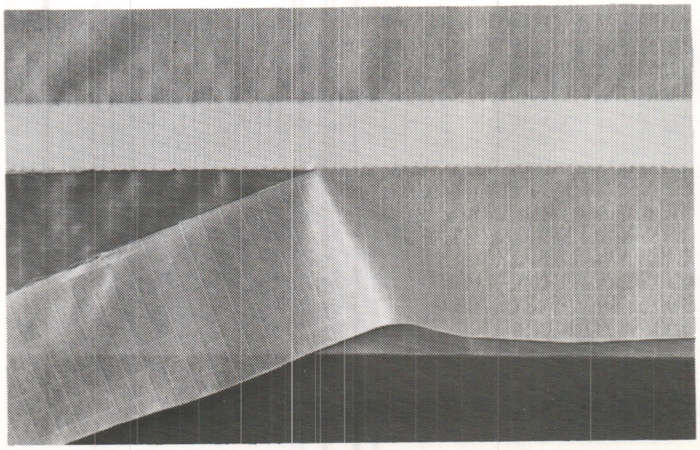


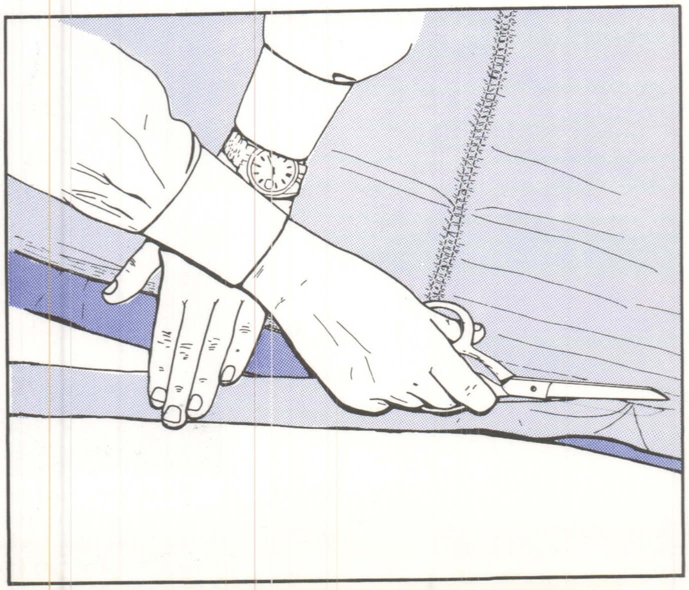
STEP 3d *Once you've pulled out the paper carrier, reach up and press the top skin tight against the reinforcement tape. Continue this process to the left wing tip.*

STEP 3e *Go back to the center and repeat this process, working to the right wing tip.*

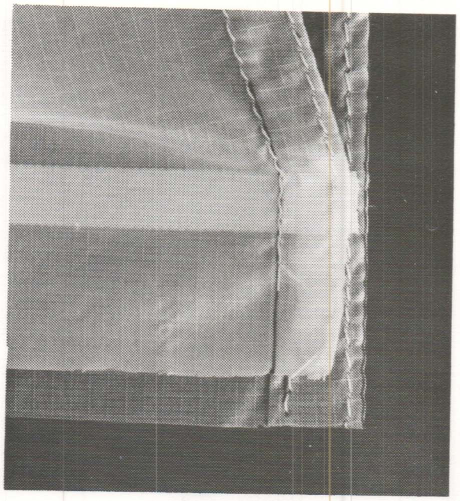


STEP 4 *Start at the left corner of the tail and trim off the excess top skin material even with the aft edge of the reinforcement tape. This is a dangerous step, it's easy to cut into the bottom skin if you're not careful. Using a weight to anchor the tail above you, hold some tension in the tail with one hand while you cut with the other. I like to lay my scissors a little flat for this step, so I can see the blade between the skins. The photo, lower left, shows a cut in progress.*

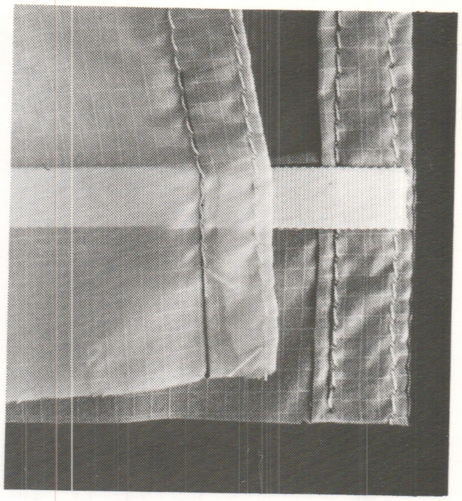




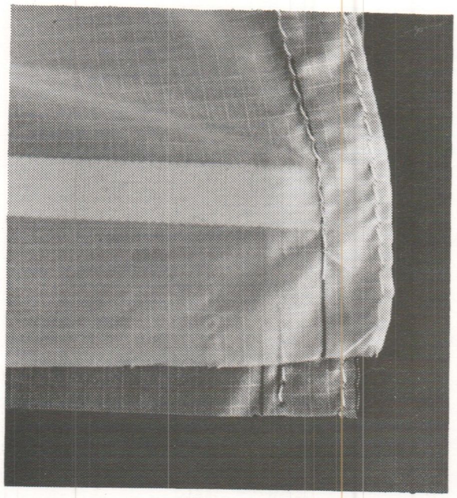
STEP 5 *This series of photos shows how to treat the corners, depending on how variations have accumulated during construction. Position the corners as required to accommodate these variations. If a corner is out of limits as seen in the bottom photos, you must go back through the tail, checking each top and bottom load seam for a misalignment you might have missed. If you find one, peel the tail apart, fix it and put the tail back together.*

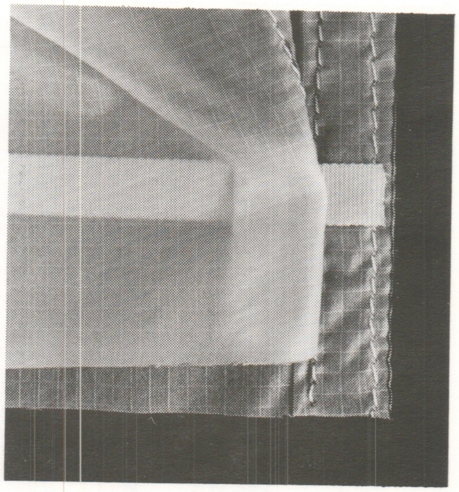


This is the theoretical perfect position. If you did a super accurate job mating the cells at the tail, your corners will look like this. Tuck the extra rib material back under the top seam and make sure it gets caught in the second stitch row of the trailing edge hem.

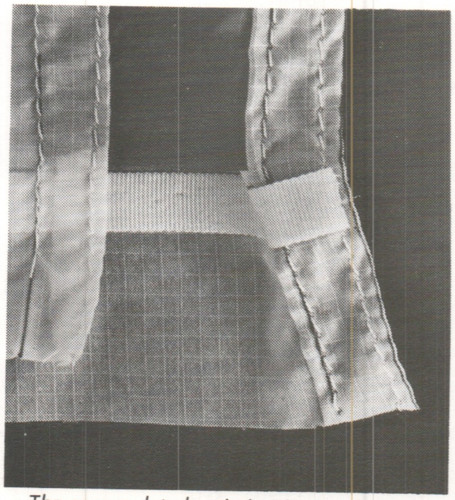


Here, the top ended up a little shorter than the bottom. The extra material in the rib allows the top seam to still lay flat. Tuck any extra rib material under the top seam and make sure it gets caught in the second stitch row of the trailing edge hem.

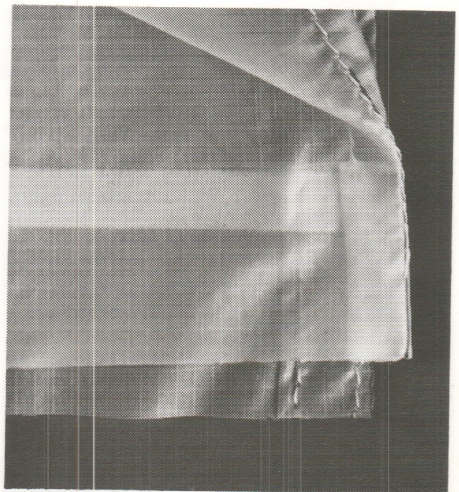




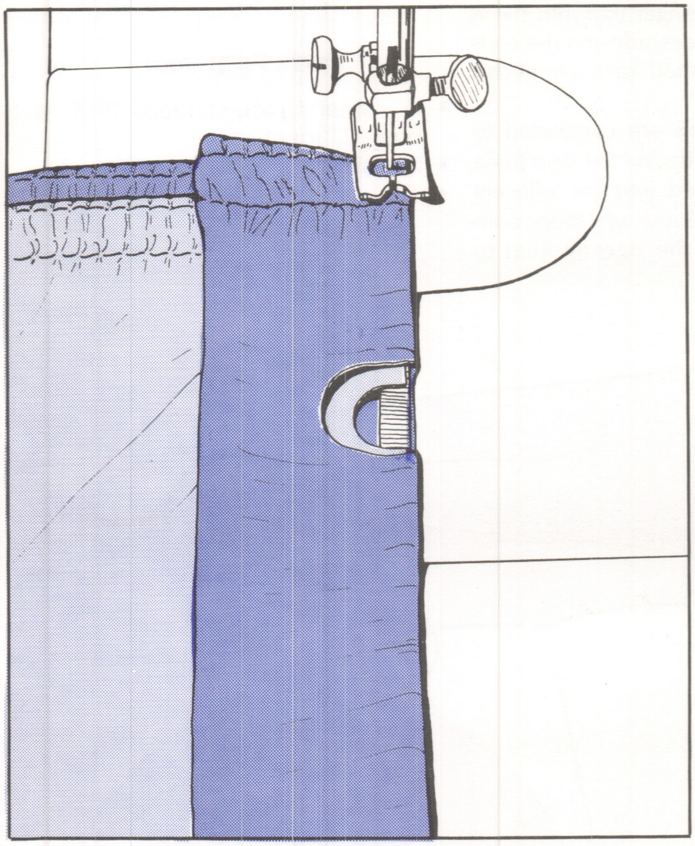
The top skin is slightly longer than the bottom, resulting in the top overhanging the bottom. In this case, roll the top seam under 180 degrees to take up the slack. The trailing edge hem is folded and sewn over this turned seam in the normal fashion. Tuck any extra rib material back under and make sure it gets caught in the second stitch pass of the trailing edge hem.



The accumulated variation is out of limits with the top skin much shorter than the bottom. Go back through the top and bottom load seams and find and correct the error.

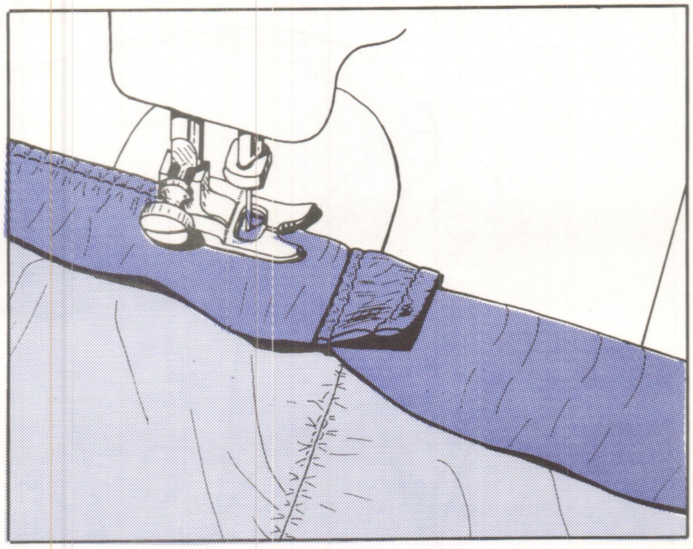


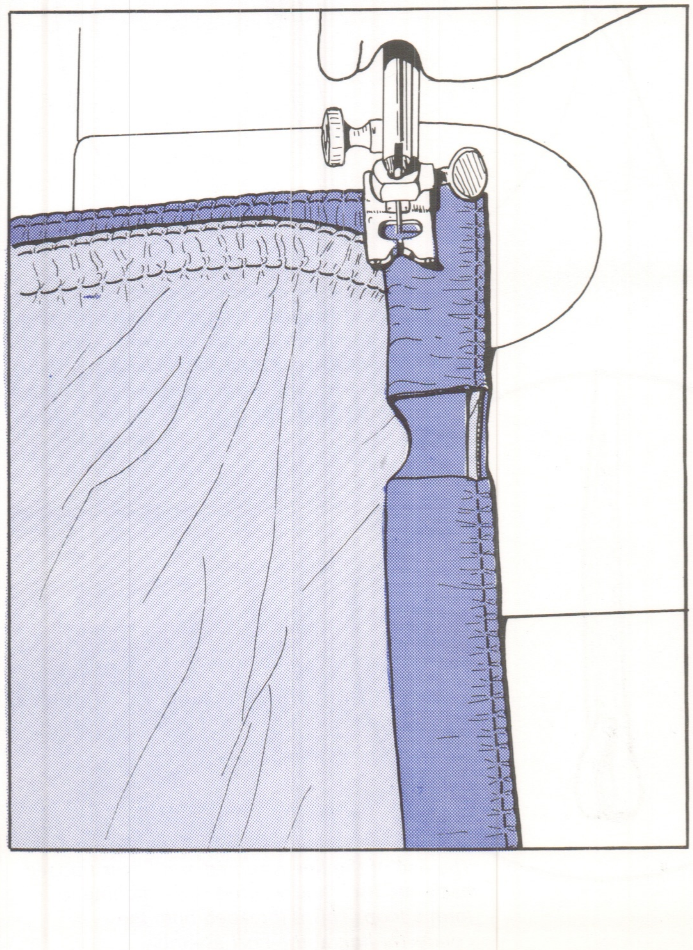
Out of limit condition where the bottom skin is too short relative to the top skin. Find the error and correct it.



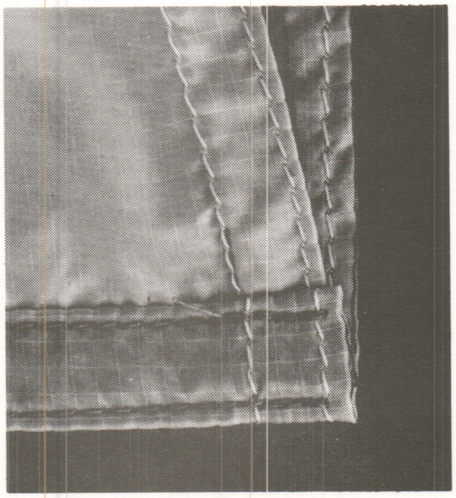
STEP 6 *Starting at the right corner of the tail fold the bottom skin seam allowance over and sew the first stitch row. See the sample marked 'tail hem'. The hem you're constructing is like the bottom load seam on the side of the canopy with the addition of the reinforcement tape. Start and stop this row with a 1 inch backstitch to lock the stitch.*

When you come to a loaded rib, fold the bottom load seam to the left of the canopy, away from the needle as you sew.





STEP 7 *Starting again at the right tail corner, fold the free end under and sew the second row of stitching. Backstitch about 1 inch at the beginning and ending of this row to lock the stitch.*



Right tail corner after trailing edge hem finished.

Final Line Work

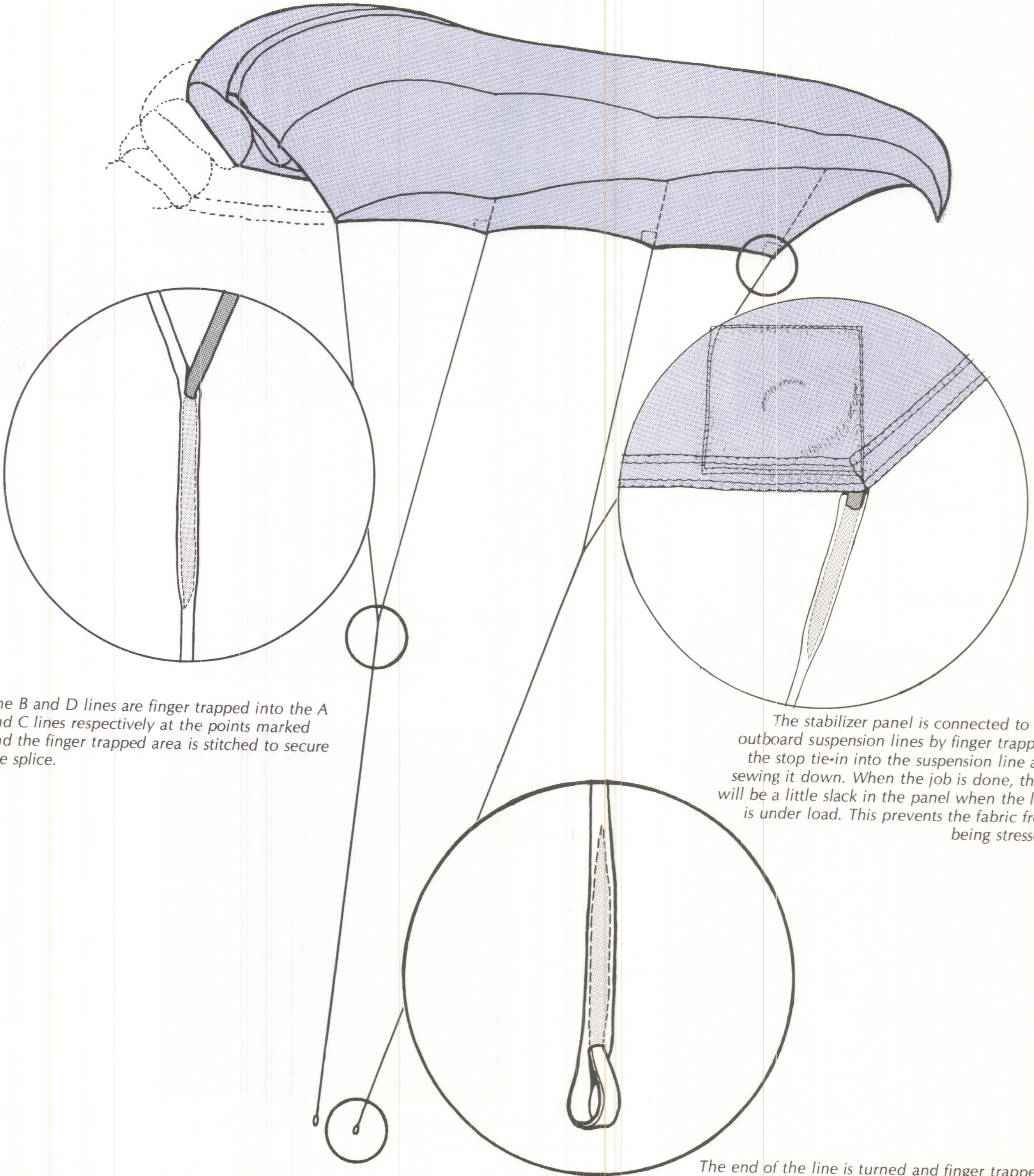
All that remains now is to finish out the suspension lines, attach the steering lines, attach and assemble the canopy on the risers. Once you get the canopy assembled, you'll do a thorough final inspection.

The B and D lines finger trap into the A and C lines to form a cascade and the ends of the lines are finished in a connector loop.

The stabilizer panels are connected to the lines on the end ribs via the stop tie-in which is finger trapped into the adjacent suspension line. You'll sew web loops onto the tail and connect the steering lines to these loops.

Parts Required:

- 8 - steering attach loops (9/16" webbing, 2" long)
- 2 - steering line assemblies
- fid



The B and D lines are finger trapped into the A and C lines respectively at the points marked and the finger trapped area is stitched to secure the splice.

The stabilizer panel is connected to the outboard suspension lines by finger trapping the stop tie-in into the suspension line and sewing it down. When the job is done, there will be a little slack in the panel when the line is under load. This prevents the fabric from being stressed.

The end of the line is turned and finger trapped back into itself and secured with stitching to form a loop. This is threaded onto the connector link at the final assembly.

Suspension Line Cascades

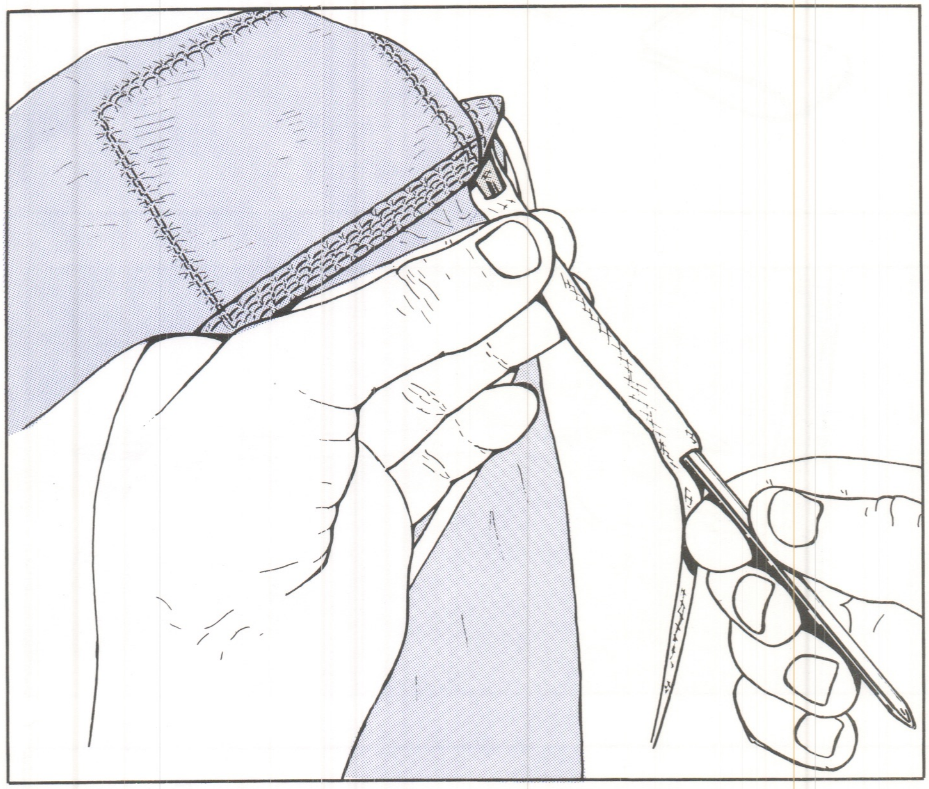
STEP 1 *Start with the lines on loaded rib assembly #1. Cut the melted end of the B line off at an angle and screw the fid on this end. Insert the fid into the A line at the blue mark, work it down into the line and bring it out at the black mark. Draw the B line down into the A line until the blue mark on the B is aligned with that on the A. Keeping these marks even, grasp the line tightly to keep the B line from moving and withdraw the fid, leaving the angled cut inside. Still keeping the alignment, massage the finger trapped area back down tight.*

STEP 2 *Stitch the finger trapped area as shown in the stitch chart.*

STEP 3 *Repeat this procedure on all the A and B lines and then on all the C and D lines (color coding is the same on all).*

Make sure that you keep the lines flat from canopy to finger trap. If you get a twist between the canopy and the finger trap, you'll have to pick the stitching out to repair it.

Stabilizer Panel Attach



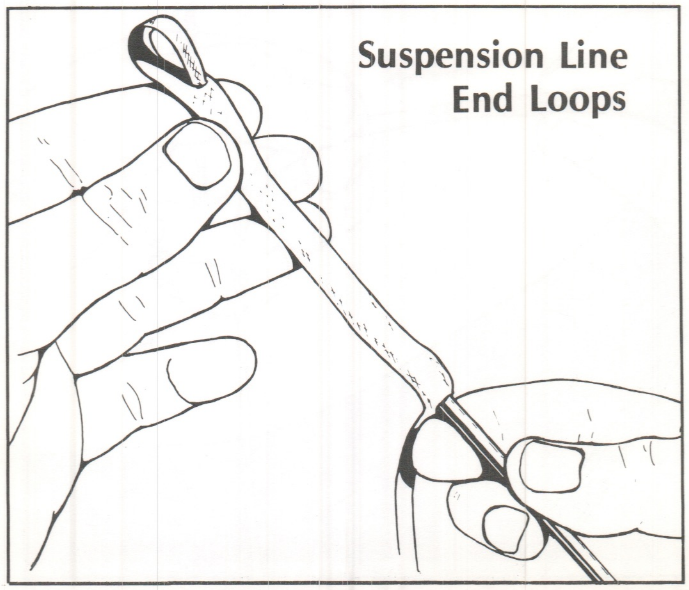
STEP 1 *The stop tie-ins attach to the B, C, and D outboard lines. Cut the end of one tie-in off at an angle and screw the fid onto this end. Insert the fid into the proper suspension line at the red mark and exit at the black mark. Draw the tie-in down all the way into the line and remove the fid, leaving the tie-in inside the line. Massage the area flat and tight.*

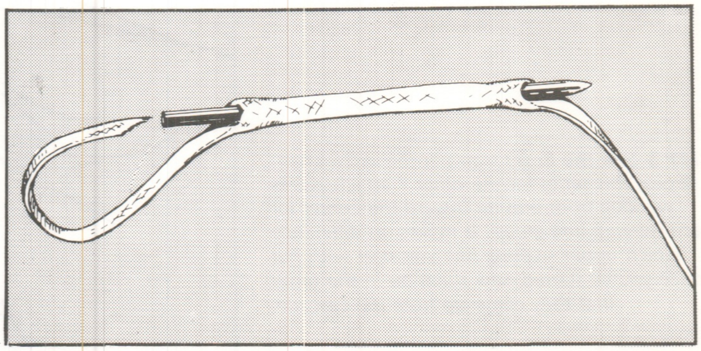
STEP 2 *Sew the finger trapped area as shown on the stitch chart.*

Completion Checkoff

- all cascades completed 20 [16]
- all stop tie-ins sewn in suspension lines 6
- connector loops formed and sewn on all suspension lines 20 [16]

Suspension Line End Loops



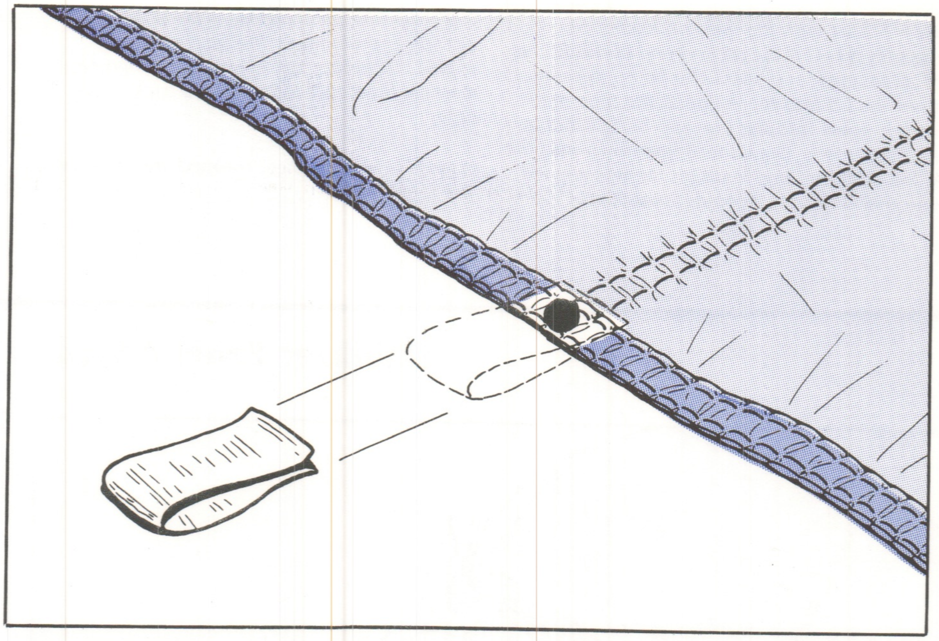


STEP 1 *Trim off the end of the suspension line at an angle. Insert the fid into the red mark and bring the tip back out at the black mark. While the fid is in the line, screw the trimmed end of the suspension line into the fid and then draw the line down inside itself, forming a loop. When the blue mark aligns with the red, the loop is the proper size. Hold the line tight and withdraw the fid and massage the area flat, making sure the marks stay aligned and the loop stays the same.*

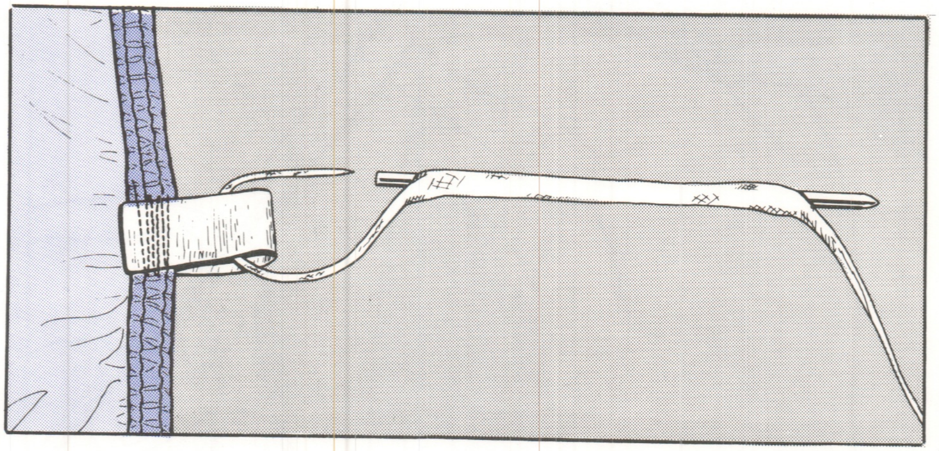
STEP 2 *Stitch the finger trapped area per the stitch chart.*

Steering Line Attachment

STEP 1 *Sew eight attach loops onto the trailing edge at the locations indicated by the heavy printed dots. Refer to the stitch chart for sewing pattern. Make sure you get the attach loops on straight and even, use basting tape if necessary to hold them in place during sewing. This section is fairly thick, and the loops must be strongly attached, so work up a dummy from scrap and get your tension adjusted for a tight, balanced stitch.*

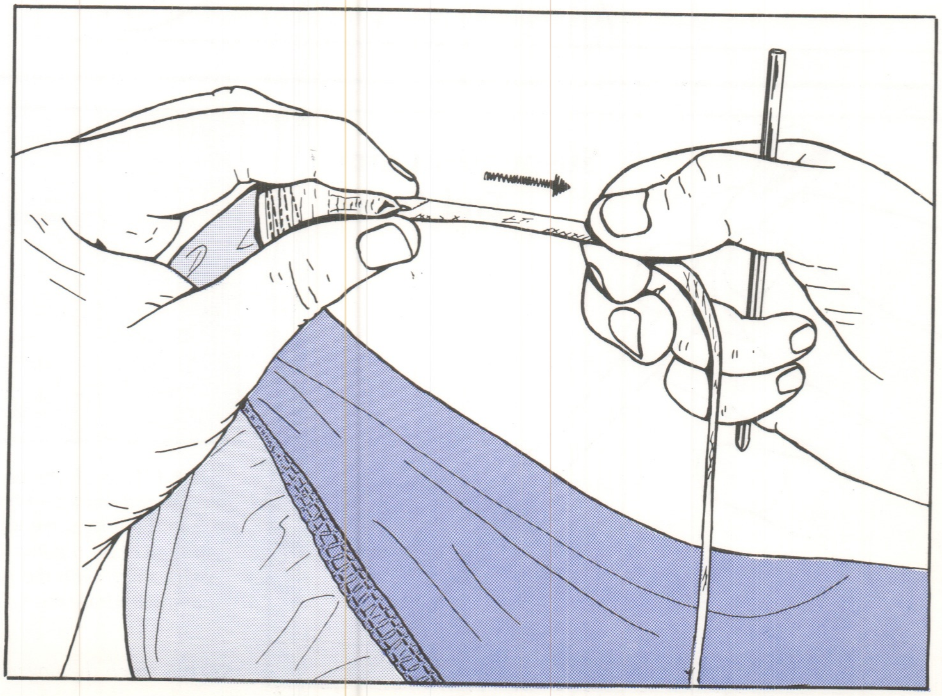


STEP 2 *Use the technique you used for the connector loop. Trim the end, and insert the fid in the line at the blue mark, exit at black. Then thread the line through the attach loop and screw the end into the fid. Draw the free end down into the line.*



Pull the fid out of the line, allowing the loop to get as small as it will before the fid slips off the end of the line. Massage the finger trap down tight.

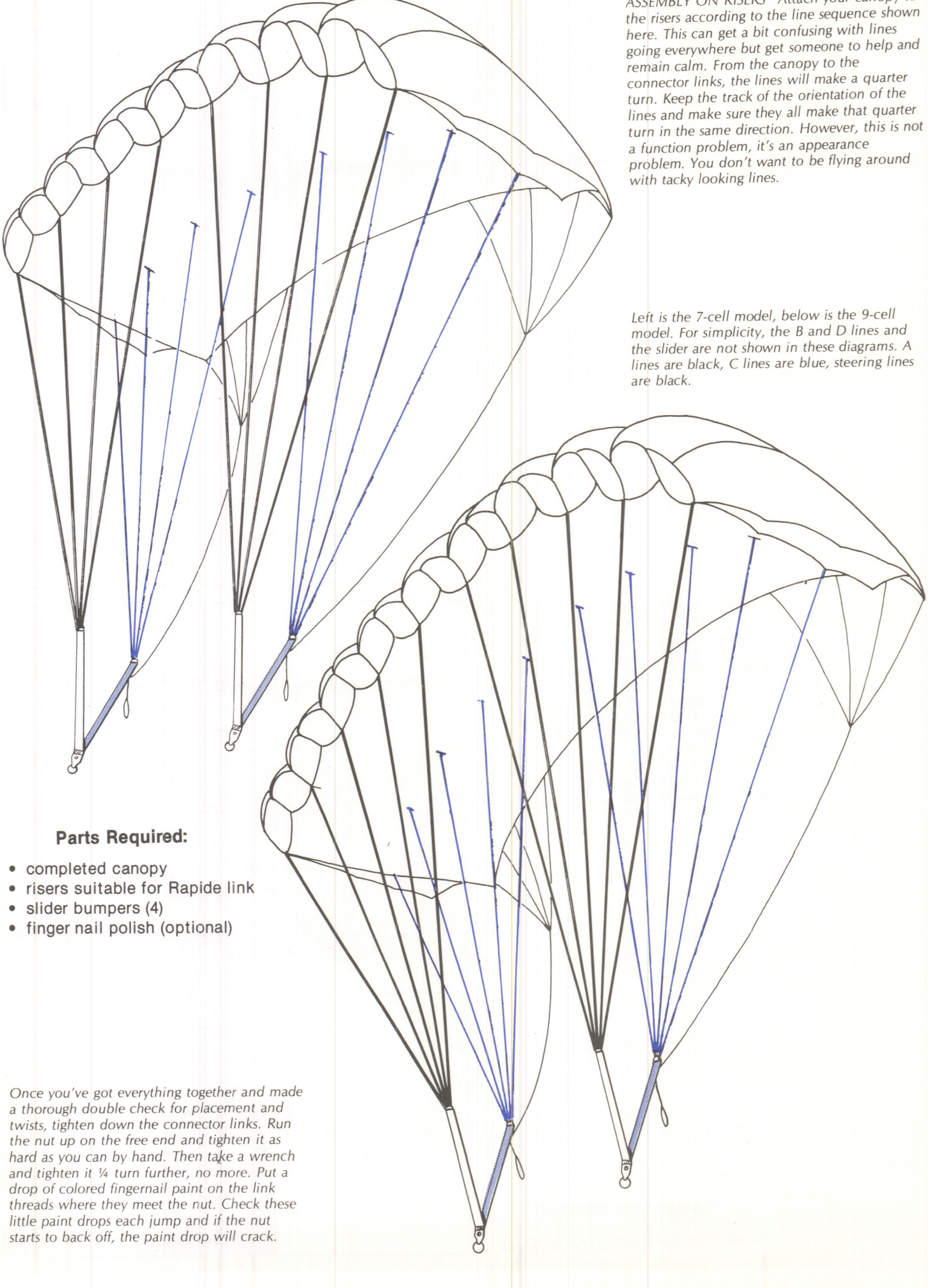
STEP 3 *Sew the finger trap per the stitch chart. Repeat this series for the other 7 attach points working from outside toward the center for each steering line group. It makes no difference which upper steering line you start with but once you've started, sew them on in the order that they come up from the cascade.*



Completion Checkoff

- each steering line group (2) attached at 4 points on tail

ASSEMBLY ON RISERS Attach your canopy to the risers according to the line sequence shown here. This can get a bit confusing with lines going everywhere but get someone to help and remain calm. From the canopy to the connector links, the lines will make a quarter turn. Keep the track of the orientation of the lines and make sure they all make that quarter turn in the same direction. However, this is not a function problem, it's an appearance problem. You don't want to be flying around with tacky looking lines.



Left is the 7-cell model, below is the 9-cell model. For simplicity, the B and D lines and the slider are not shown in these diagrams. A lines are black, C lines are blue, steering lines are black.

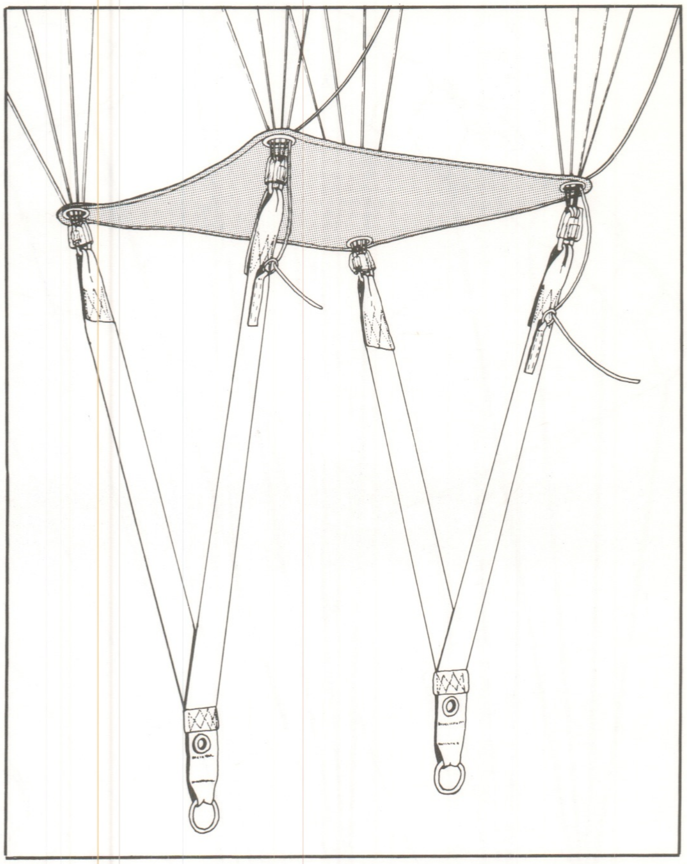
Parts Required:

- completed canopy
- risers suitable for Rapide link
- slider bumpers (4)
- finger nail polish (optional)

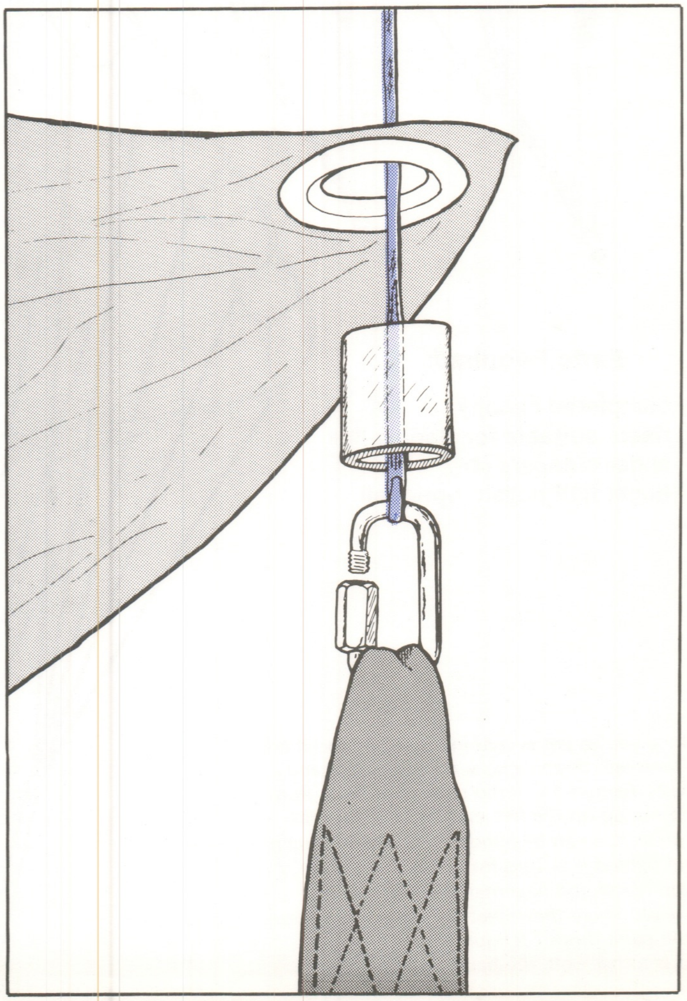
Once you've got everything together and made a thorough double check for placement and twists, tighten down the connector links. Run the nut up on the free end and tighten it as hard as you can by hand. Then take a wrench and tighten it ¼ turn further, no more. Put a drop of colored fingernail paint on the link threads where they meet the nut. Check these little paint drops each jump and if the nut starts to back off, the paint drop will crack.

The slider is installed so that each suspension line group goes through the proper grommet. Each grommet is coded for the line group it takes. The printed side of the slider faces toward the canopy.

LA = left half, A lines
RA = right half, A lines
LC = left half, C lines
RC = right half, C lines



When connecting the line to the riser, bring the line down through the proper slider grommet, through the slider bumper, and thread it on the link. The lines should all be faced the same way (it doesn't matter which as long as it's the same) and should have no twists. The steering lines are brought down through the grommets, left line through the LC and right line through the RC grommets. They DO NOT go through the slider bumper, but go directly to the keeper ring on the riser. Refer to the harness/container instructions for the proper method for attaching the toggle to the steering line.



Completion Checkoff

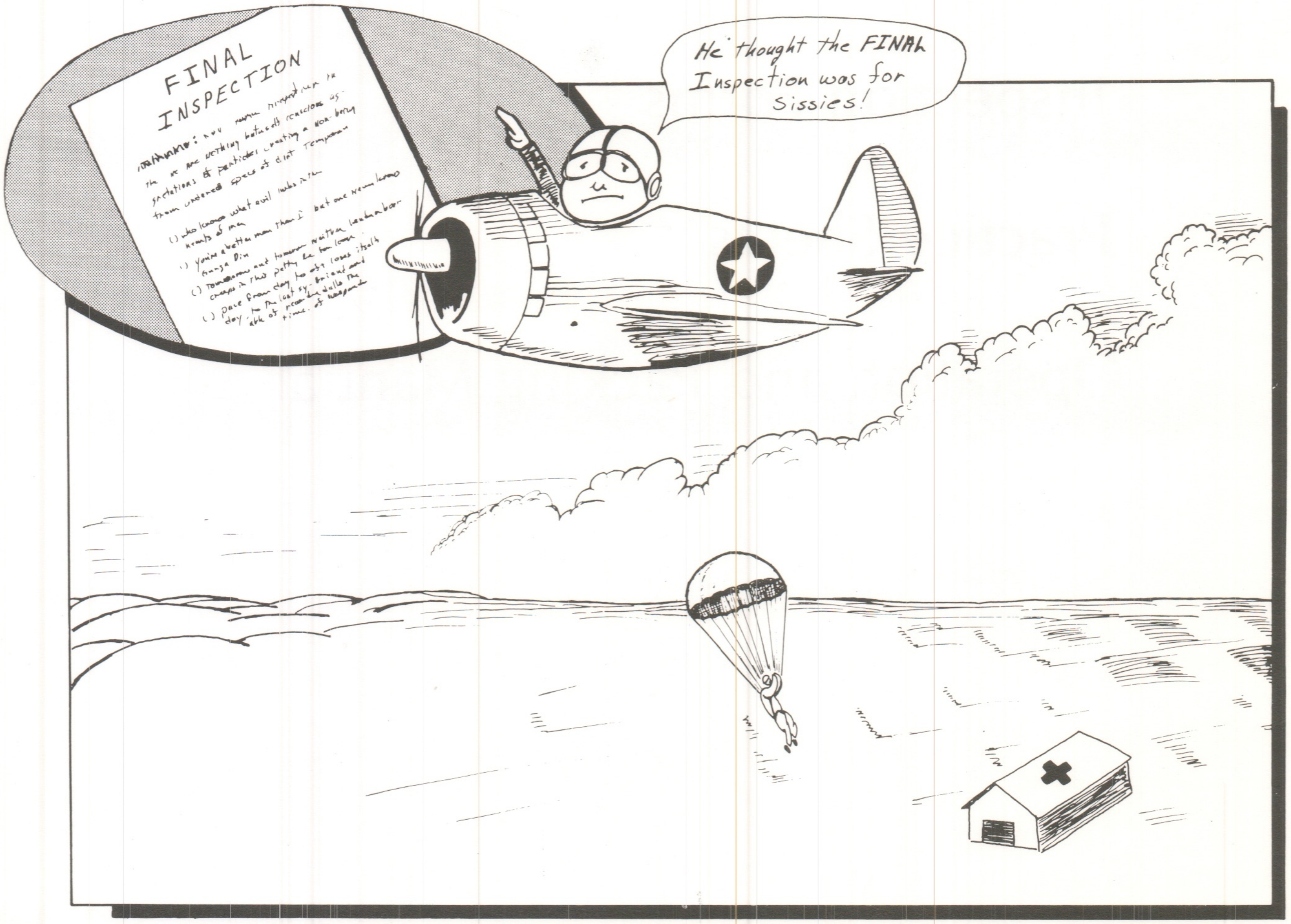
- all lines connected to the risers.

Final Inspection Sequence

Although you've now become an expert on your canopy and are sure it's OK, it's perfectly normal to miss a little something here and there. Now is the time to go back through your canopy, in a systematic fashion and check all work to make sure it was done to specifications. Usually if you find a discrepancy, it'll be something you forgot to do like sew a finger trap or install a confluence wrap.

The Final Inspection program consists of three separate inspections of the canopy. The first is the one you are about to do, the Static Inspection, done after finishing the canopy and before jumping it. The second is the Subterminal Inspection, the inspection done after the first jump with a delay of no more than five seconds. Last is the Terminal Inspection done after the first full speed terminal opening following a delay of at least 12 seconds. The first inspection makes sure everything is in the right place, the last two make sure everything's staying in the right place. See the instruction section for each inspection.

The inspection sequence is item by item throughout the canopy. You'll check one thing, say an A line attach point, all the way through the canopy, then go back and check another item all the way through and so on, until you're finished. This takes a little longer than checking all items in each cell, from cell to cell, but makes for a more accurate inspection; there's less chance of missing something. Once you have completed your inspection and jump test report, you should send one copy to the factory so we can include it in your file and attach your copy to your log book.


FINAL INSPECTION
He thought the FINAL Inspection was for Sissies!

Appendix

9 Cell Canopy Assembly Sequence

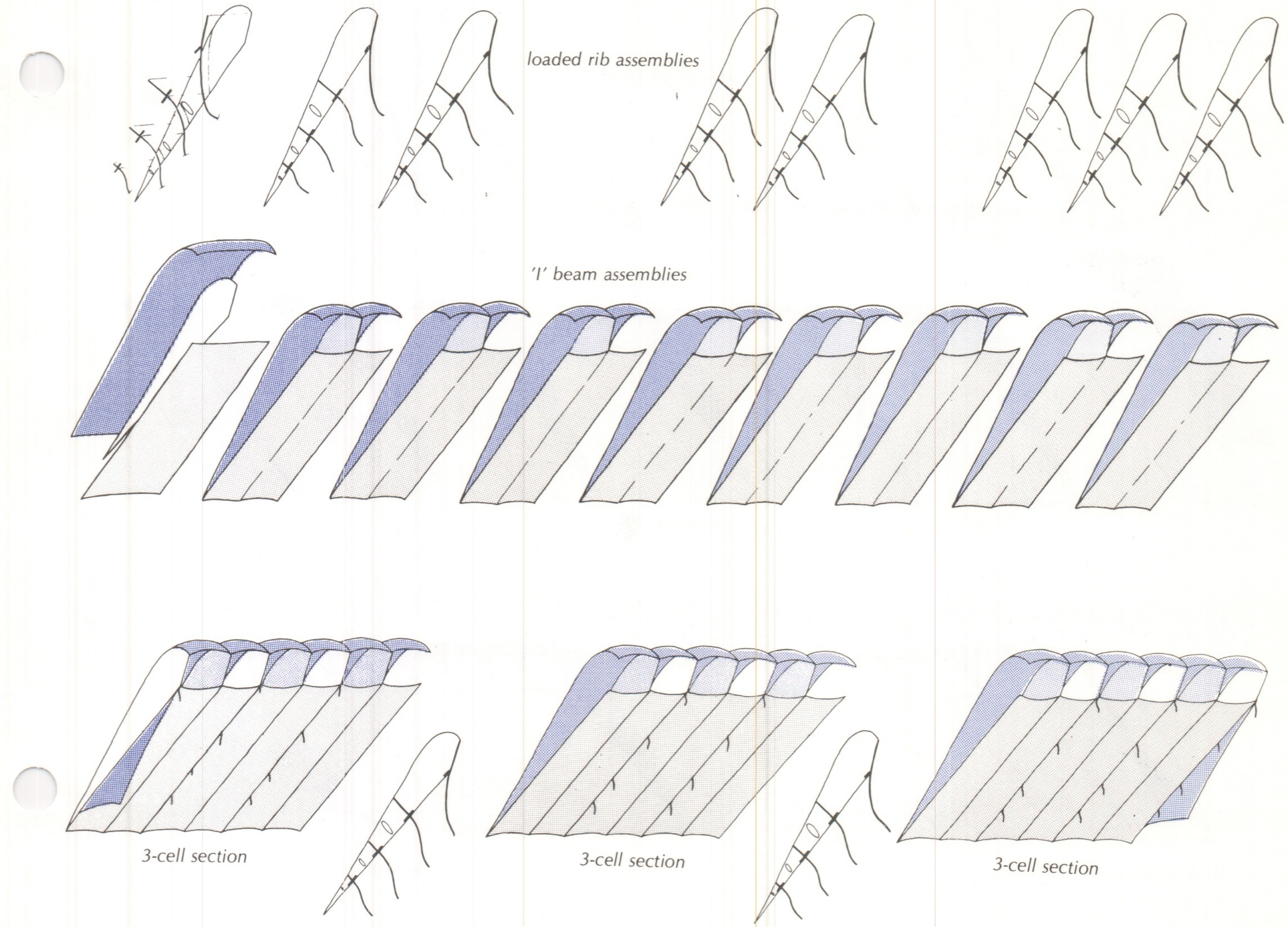
7 Cell Canopy Assembly Sequence

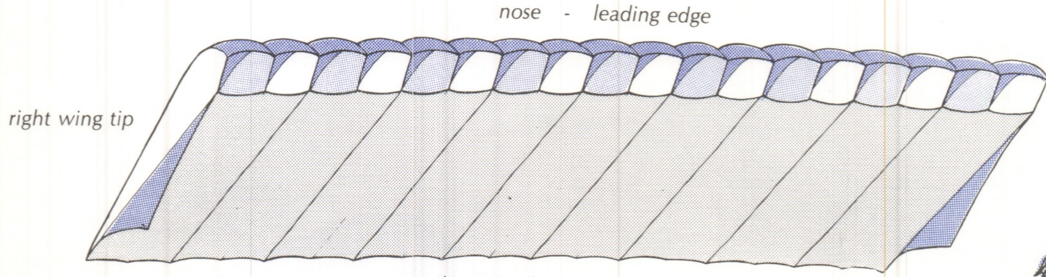
Stitch Chart

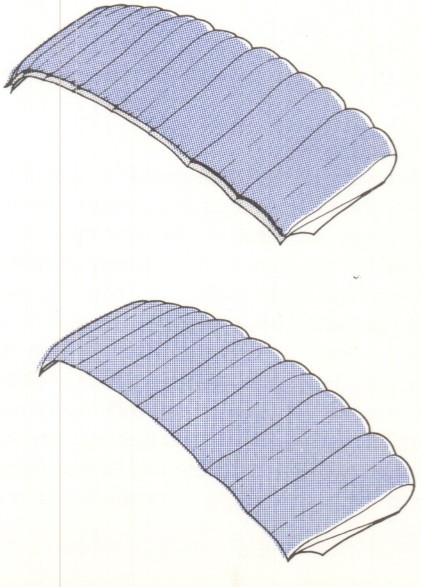
Inspection Forms

Practice Sheets

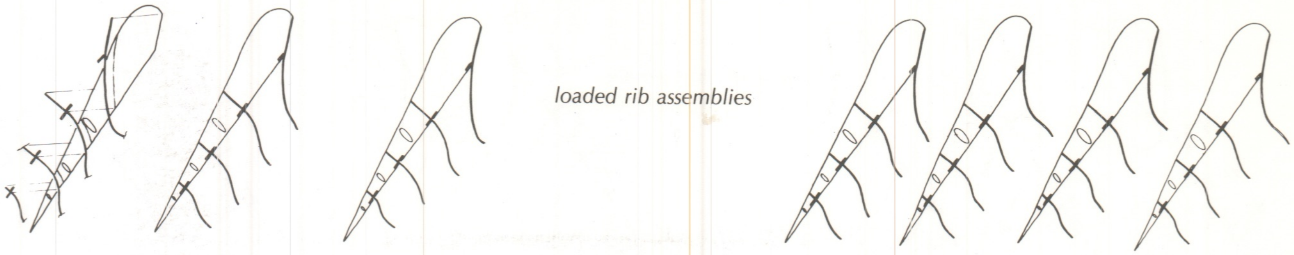
Operation and Packing Manual



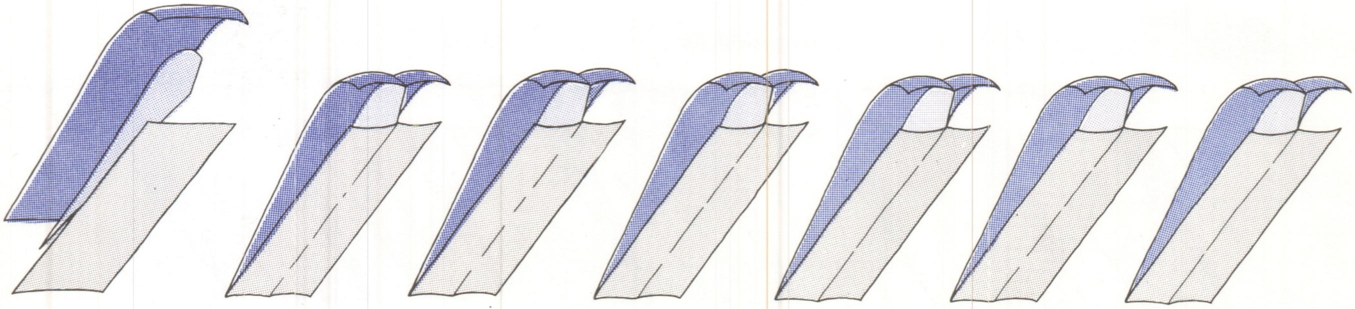




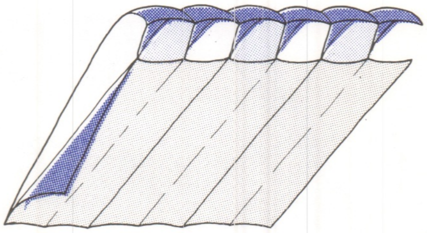
Overview, 9 Cell Canopy: The assembly sequence begins with preparation of the parts [not shown above] such as suspension line preparation, sewing leading edge hems, and applying stabilization and basting tapes to the ribs and skins. From here you will put together a series of increasingly complex subassemblies. First the suspension lines are sewn to all ten loaded ribs [top row above]. Next, the top and bottom skins are sewn to the unloaded ribs to form the I beam subassemblies. These subassemblies are then mated by sewing loaded ribs into position between two adjacent I beams. This process is repeated several times to produce three units of three cells each. These three are then joined with the two remaining loaded ribs to complete the canopy. At the trailing edge, the top and bottom skins are sewn together to close the tail. The body of the canopy is now complete and all that remains is to finish the suspension lines with cascades and connector loops, to attach the steering lines, and to attach the risers to the lines.



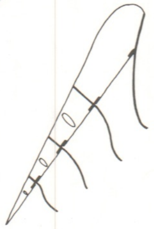
loaded rib assemblies

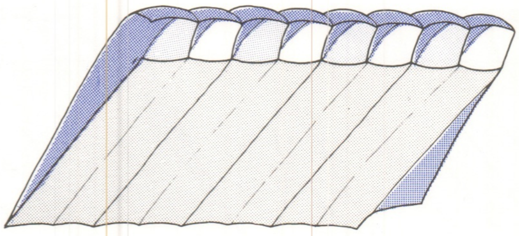


'I' beam assemblies

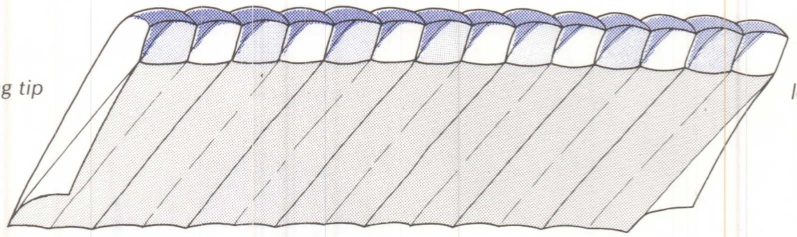


3-cell section

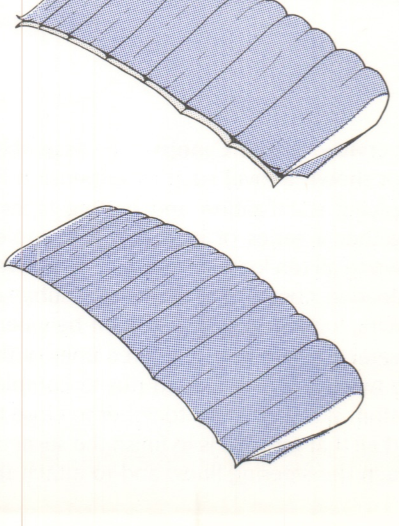




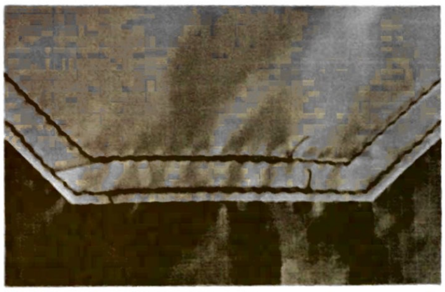
4-cell section



Overview, 7 Cell Canopy: The assembly sequence begins with preparation of the parts [not shown above] such as suspension line preparation, sewing leading edge hems , and applying stabilization and basting tapes to the ribs and skins. From here you will put together a series of increasingly complex subassemblies. First the suspension lines are sewn to all eight loaded ribs [top row above]. Next, the top and bottom skins are sewn to the unloaded ribs to form the I beam subassemblies. These subassemblies are then mated by sewing loaded ribs into position between two adjacent I beams. This process is repeated several times to produce a left side unit of four cells and a right side of three cells. These two are then joined with the remaining loaded rib to complete the canopy. At the trailing edge, the top and bottom skins are sewn together to close the tail. The body of the canopy is now complete and all that remains is to finish the suspension lines with cascades and connector loops, to attach the steering lines, and to attach the risers to the lines.

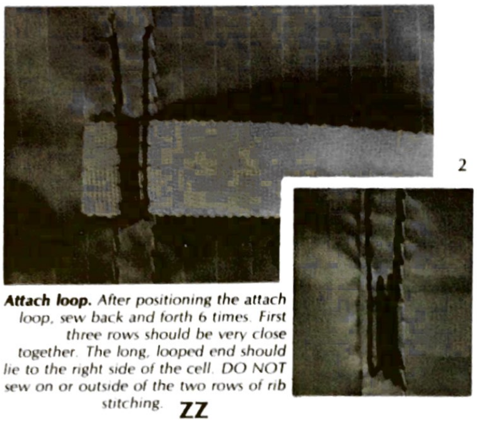


Pilot Chute Attach System



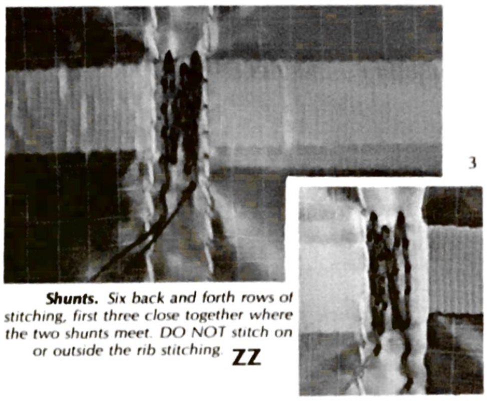
1

Doubler patch. Two rows of stitching around the edge of the doubler patch, the first spaced 1/8 inch in from the edge and the second about ¼ in from the first. Overlap about 1 inch.



2

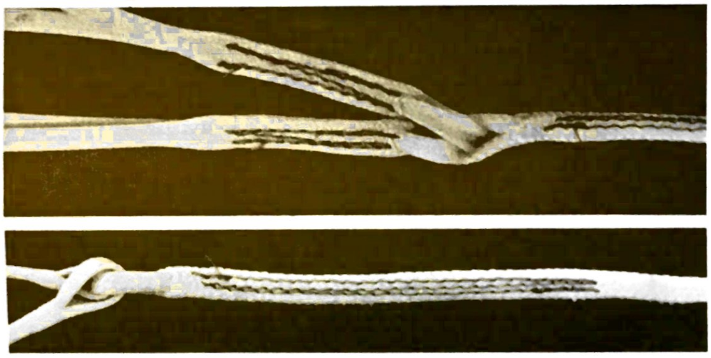
Attach loop. After positioning the attach loop, sew back and forth 6 times. First three rows should be very close together. The long, looped end should lie to the right side of the cell. DO NOT sew on or outside of the two rows of rib stitching. **ZZ**



3

Shunts. Six back and forth rows of stitching, first three close together where the two shunts meet. DO NOT stitch on or outside the rib stitching. **ZZ**

Steering Line Stitching

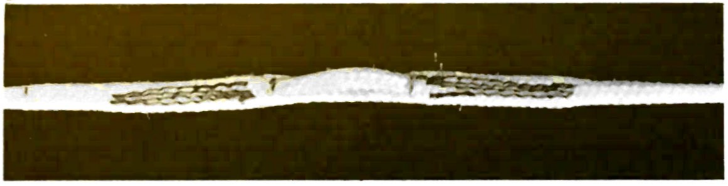


4

Steering line. Three back and forth rows of stitching in each finger trapped joint. On the lower loop, sew to ½ inch above the end of the line inside. **ZZ**

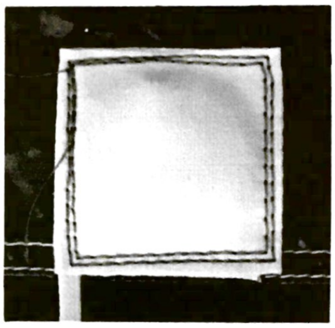
Brake loop. Four back and forth rows in each finger trapped joint. Sew to the end of the inserted line inside. **ZZ**

5

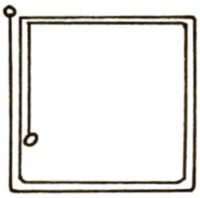


Slider Stop

Stabilizer tie-in. Start at the top of the tie-in and sew around three sides, insert the washer, and sew across the open side. Sew around once more.

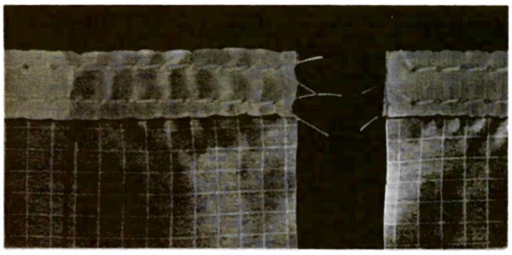


6



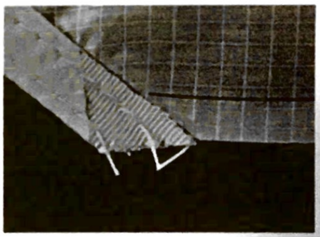
Zig Zag Option If you have a zig zag machine, you can replace the straight stitching with a zig zag stitch in some places. It'll make no practical difference in the strength but it will speed up some jobs. Set the stitch length adjustment to twice the normal straight setting. If you've been using 7 stitches, set it at 14. When sewing lines, adjust the width of the zig zag so the stitch width is about ⅓ the width of the line. Don't make your stitch so wide that the stitches are only going through the edges of the line. You can use the zig zag stitch wherever you see the notation: **ZZ.**

Leading Edge Hems



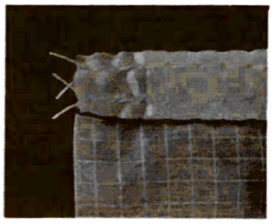
Bottom skin, leading edge hem. Sew both rows of stitching from edge to edge.

7



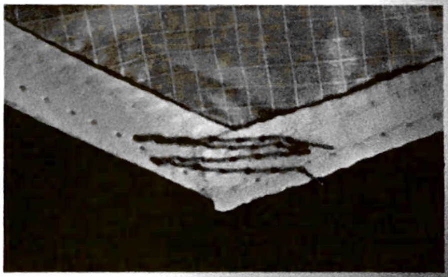
9

Unloaded rib, lower corner. Sew both rows to the end of the rolled hem at the top and bottom corners.



Top skin, leading edge hem. Sew both rows to the edge of the hem.

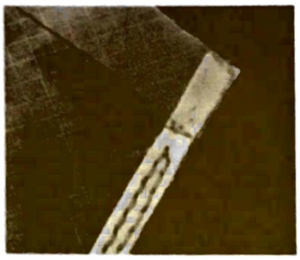
8



10

Lower corner, stabilizer panel. Sew the rolled hems of the stabilizer panels from front to rear edges. After you have sewn the hems, reinforce the lower corner of each panel with four rows of back and forth stitching as you see here.

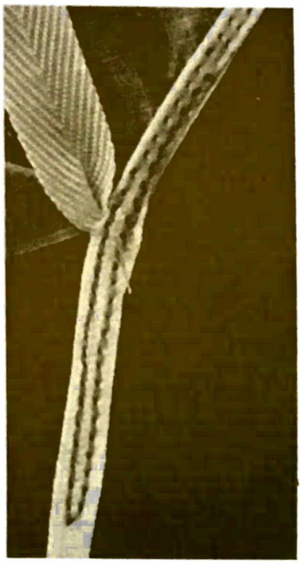
Suspension Line Stitching

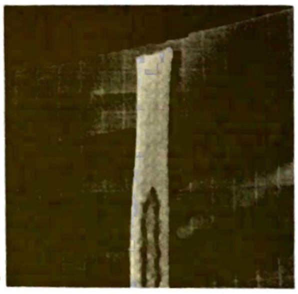


'A' line. Start 1 inch above the cross tape on the outside edge of the line, sew down just past the end of the tape inside the line, sew back up along the inside edge to the end of the line inside the fabric, turn and sew back down along the outside edge, to the bottom edge of the rib.

11

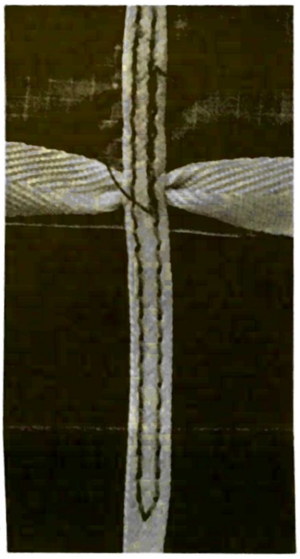
12





13

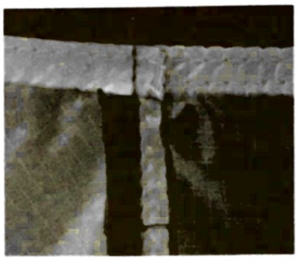
14



B, C, and D lines. Sew the same stitch pattern as on the A lines. Turn around at the top just below the stabilizing tape so this tape isn't caught in the stitching.

Tension adjustment. A single layer of fabric and a single line don't require much tension when sewn separately, but when sewn together, a surprising amount of top tension is required to get the top thread to pull through the layer of fabric underneath the line. Sew on some dummy samples for tension adjustment trials before sewing the real thing.

Unloaded Rib Stitching

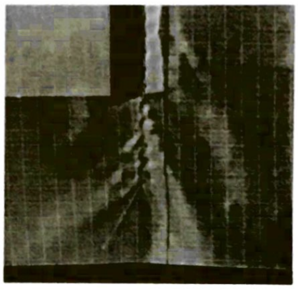


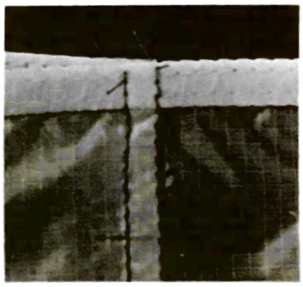
15

First top stitch, nose. First stitch runs along outside edge of stabilizing tape. It isn't necessary to back stitch at the start, a confluence wrap will secure this join.

First top stitch, tail. Continue the stitch about ½ inch past the end of the rib.

16



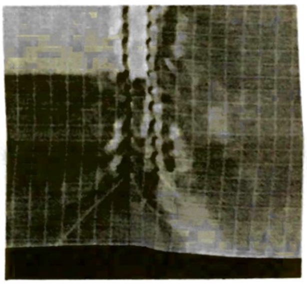


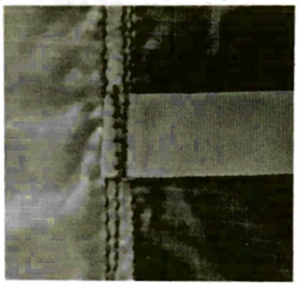
17

Second top stitch, nose. Stitch should be parallel, about ¼ inch from the first stitch.

Second top stitch, tail. The stitch goes past the rib underneath about ½ inch.

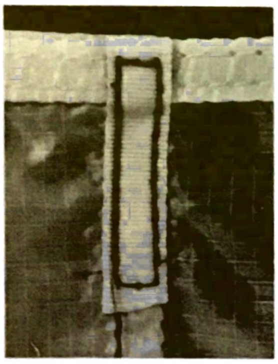
18





19

Packing tab. Sew back and forth three times across the packing tab. DO NOT stitch on or outside of the rib stitching, and make sure the rib is lying flat and out of the way underneath.



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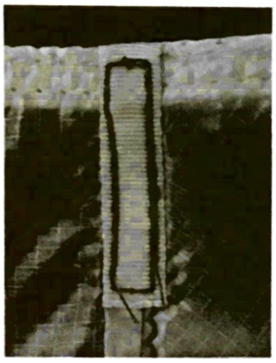
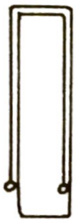
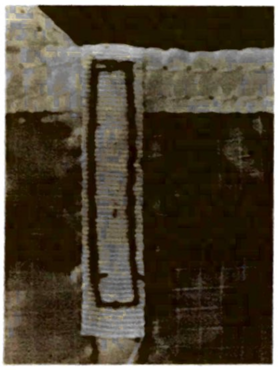


Confluence tape, top skin. Sew with the outside surface up. Far right shows outside view, near right is inside view.

21 **ZZ**





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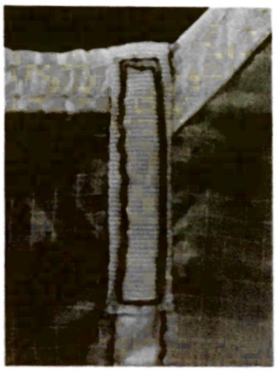
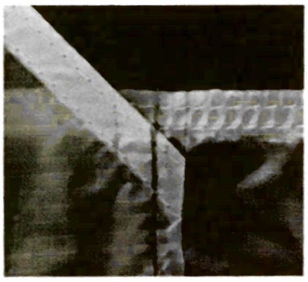


23

Confluence tape, bottom skin. Sew identical to top tape. Far right, outside view, near right, inside view. **ZZ**

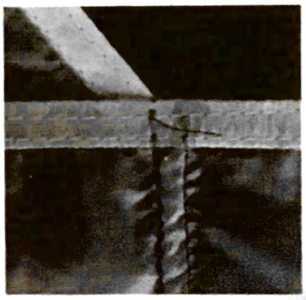
24

First bottom stitch, nose. Start the stitch in the leading edge hem of the bottom skin and then after a couple of stitches, position the rib and continue sewing to about ½ inch past the end of the rib.

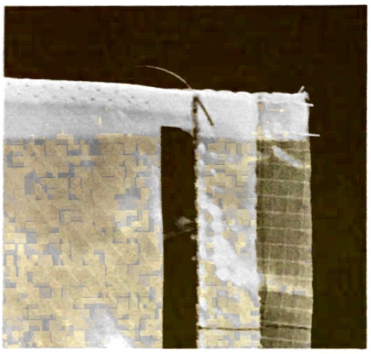


Second bottom stitch, nose. Sew parallel to the first stitch as you did on the top skin.

25



Loaded Rib # 1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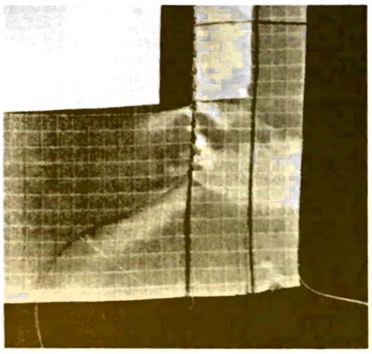
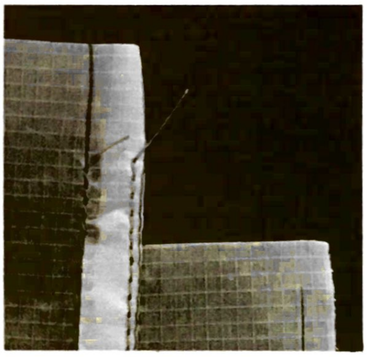

27

First stitch, top, nose and tail. *Briefly tighten top tension when sewing across lines.*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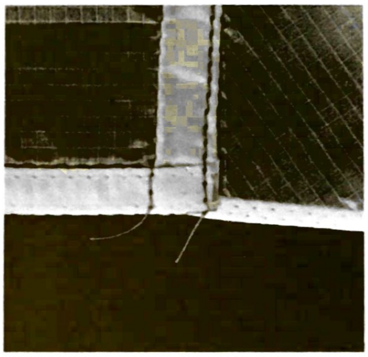
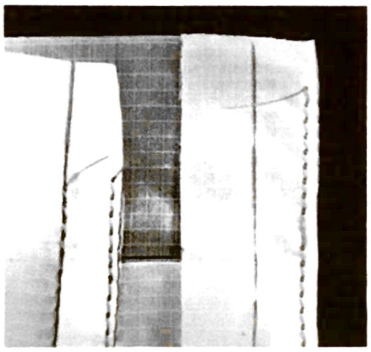
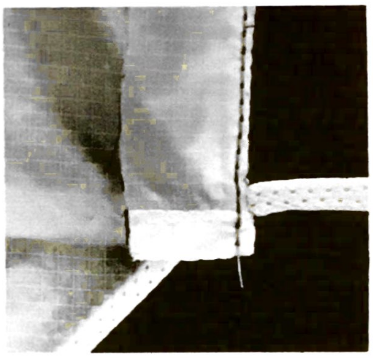
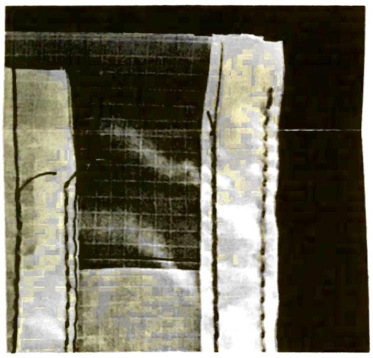

29

Second stitch, top, tail and nose.




31

First stitch, bottom seam. *Briefly tighten tension when going across lines.*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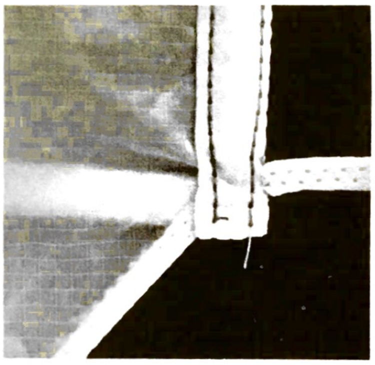
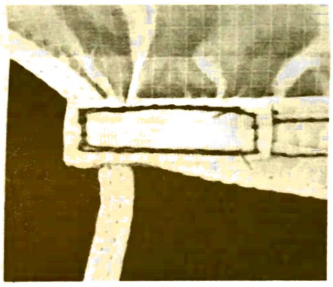

33

Finished bottom seam. *Briefly tighten tension when sewing across lines.*

Left Stabilizer Panel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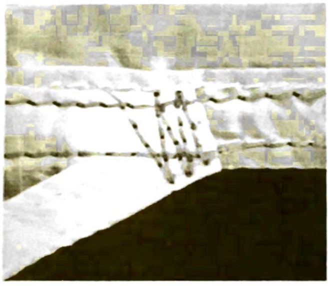
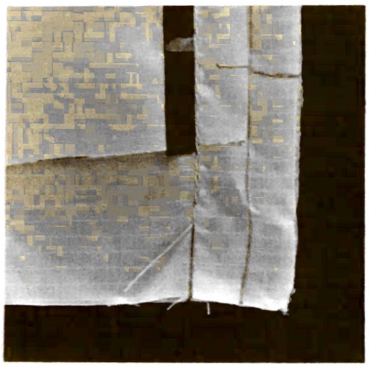
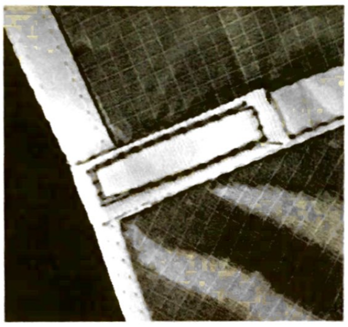

35

Left wing tip Completion. *After the stabilizer panel is in place, sew confluence tapes in place with the same stitch pattern used on the unloaded rib tapes. Above left, is the bottom seam confluence tape. top seam is shown below [37]. The tail end of the stabilizer panel must be anchored with 5 back and forth rows of stitching.* **ZZ** *A tight zig zag will work here.* **Do not sew above the second stitch row.**

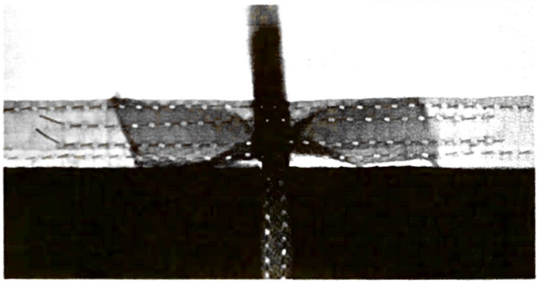
Loaded Rib Installation


36

First stitch, top, detail at tail. *This stitch is like that on the previous loaded rib. It is important to sew off the rib onto the ending guide line. This stitch determines the total distance across the tail when the cells are joined. Tighten top tension briefly when going across lines.*

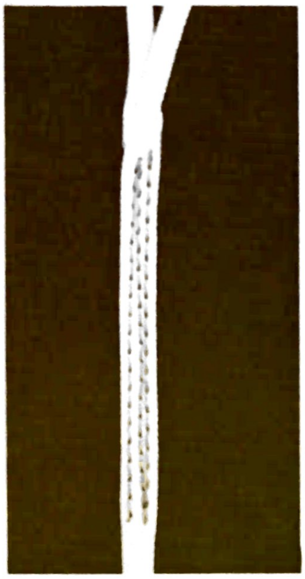

37

Top confluence tape, *all loaded ribs.*


38

Lower attach point, B, C, and D lines. *Two parallel rows of stitching starting and ending about ½ inch past the edges of the cross tape.*

Final Line Work



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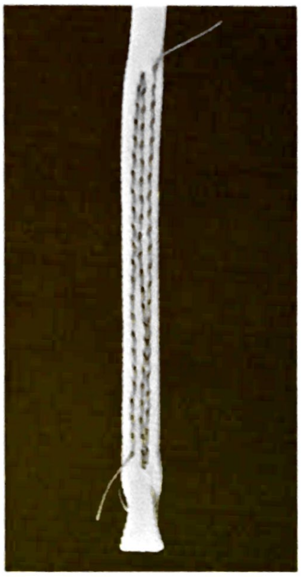

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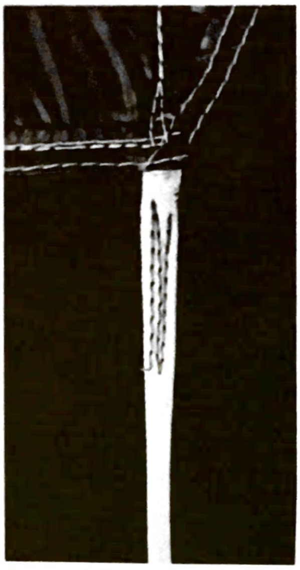
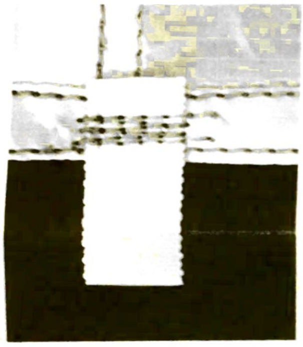
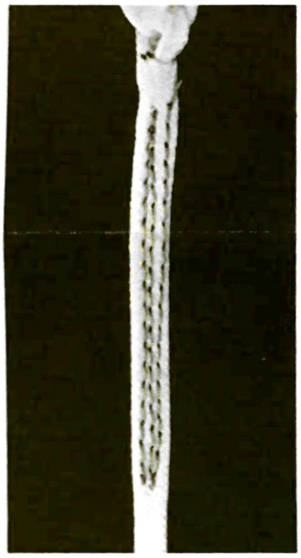


41

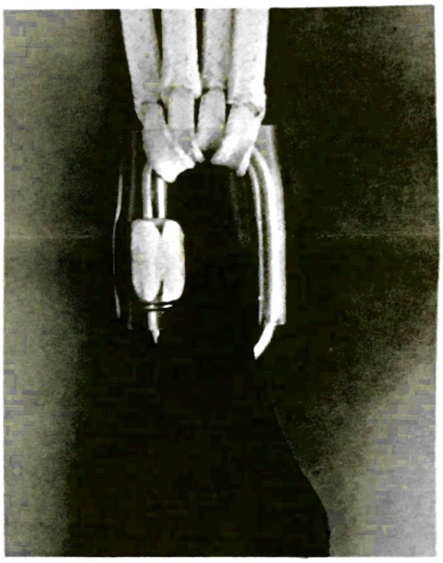
Cascade and connector loop. *Sew three straight rows from insert point to ½ inch short of end of inside part*



Tail attach. Sew attach loop to tail with 5 back and forth rows.
Make sure all stitches are through the reinforcement tape inside the hem.
Steering line finger trap is sewn like connector loop.



43



44

Connector link. The slider bumper is forced down around the connector link after the lines are in place and the connector link tightened.

Exercise #3

Remember!

1st Needle in paper.

2nd Presser foot down.

3rd Sew.

Start

At the end……

1st Raise Needle to highest position.

2nd Raise presser foot.

3rd Remove material

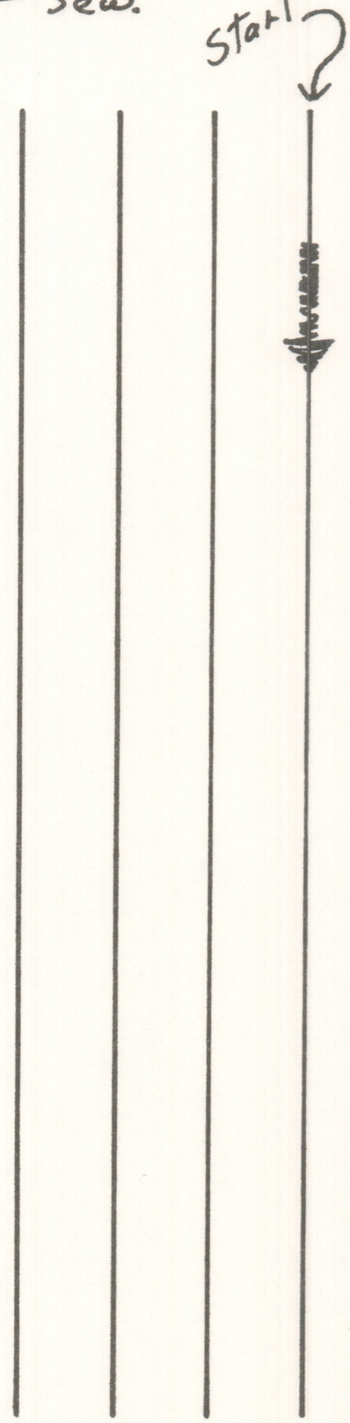
Exercise #3

Remember!

1st Needle in paper.

2nd Presser foot down.

3rd Sew.



At the end......

1st Raise Needle to highest position.

2nd Raise presser foot.

3rd Remove material

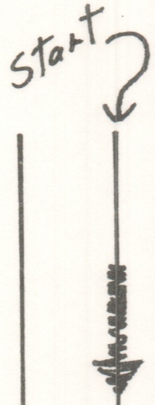
Exercise #3

Remember!

1st Needle in paper.

2nd Presser foot down.

3rd Sew.



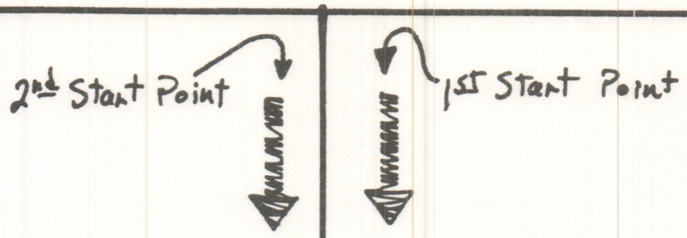
At the end……

1st Raise Needle to highest position.

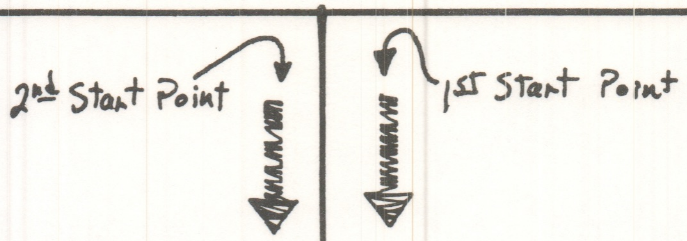
2nd Raise presser foot.

3rd Remove material

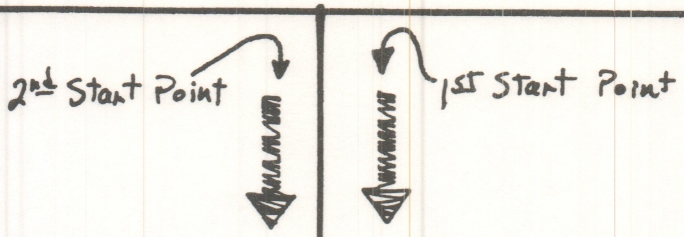
Exercise #4



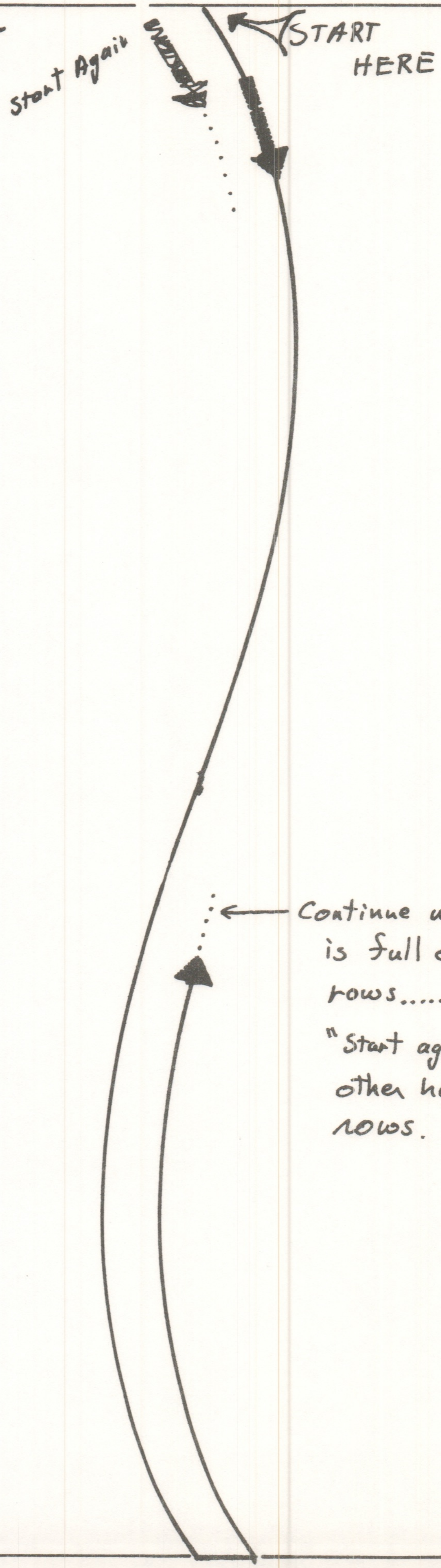
Exercise #4



Exercise #4

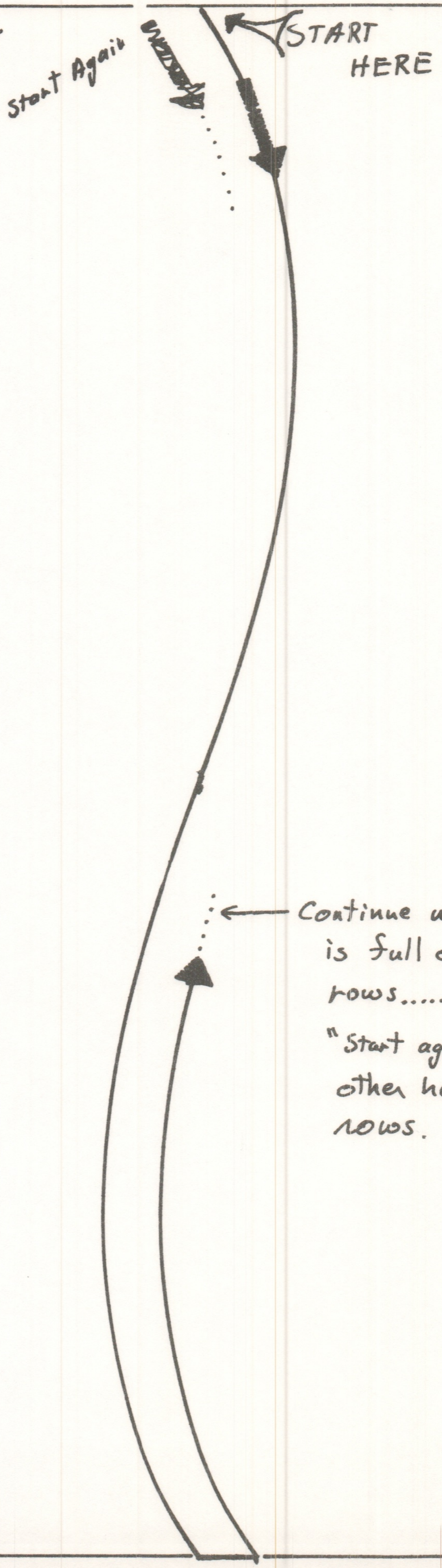


Exercise #5



Continue until this half of page is full of curved parallel rows……. then hop over to the "Start again" place & fill up the other half with beautiful curved rows.

Exercise #5



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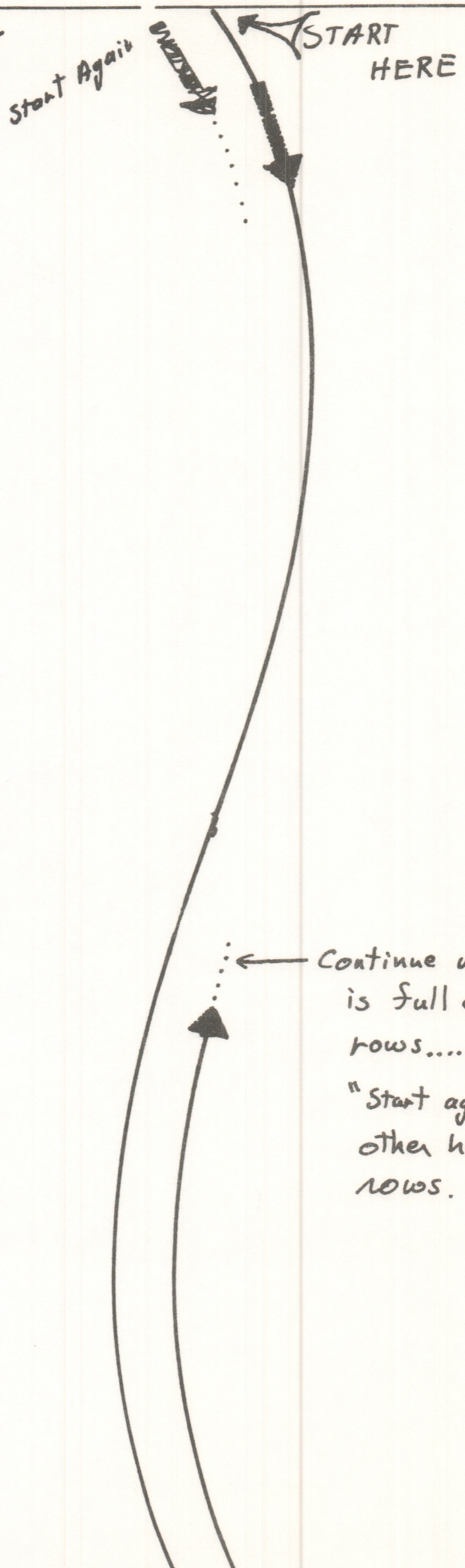
Exercise #5



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